

ARITHMETICK

COMPLETED in all its

RULES

BOTH

Vulgar and Decimal;

THE

Extraction of the Square and Cube
Roots, as also the Calculations of Simple
and Compound Interest, with all Useful
TABLES.

The WHOLE explained *12 B d*
In a Practical, Easy, and more Familiar METHOD,
than was ever yet published.

By GIDEON ROYER,

Writer, Flourisher, and Embellisher to the late Kings,
CHARLES, JAMES, WILLIAM, and Queen
ANNE, (for more than 30 Years) Teacher of ARITH-
METICK for above 50 Years) and formerly Scholar to
the late Mr. JOHN KERSEY.

LONDON:

Printed for B. CREAKE, at the Bible in Fearn-
street against St. James's Church. 1721.

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L O N D O N

Printed for B. GRAY, at the Bible in Feathers
Street against St. James's Church. 1724.

To the Right Honourable
Richard Edgecombe, Esq;

ONE OF THE
Lords of his Majesty's Treasury,

AND
Member of PARLIAMENT

FOR
Mount Edgecombe,

In the COUNTY of
CORNWALL.

THIS
Treatise of ARITHMETICK
WITH
All Submission is humbly Dedicated,

*By your most humble,
and obedient Servant;*

GIDEON ROYER,

A

THE

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THE
PREFACE.

HAVING for above Fifty Years been a Proficient and Teacher in those two most useful, necessary, and commendable Arts of *Writing* and *Arithmetick*; and having by my Skill, attained to the Honour of being Writer, Flourisher, and Embellisher to the late Kings, for more than 30 Years, and likewise for three Years to Queen Anne: And being now come to an advanced Age, I was willing to leave this Memorial behind me, in order to initiate Posterity in those Sciences, when I shall be no more.

In order to this, I have in the following Treatise of *Arithmetick*, first explained in a plain, accurate, and succinct Manner, all the Rules of *Vulgar Arithmetick*, and *Fractions*: And whereas most of our Writers of *Arithmetick*, in their most difficult Questions, have only made their *Pacits*, and some none; I have not only explained those Questions; but for the Benefit and Ease of young Learners, have work'd them throughout; as well knowing, that for want of such Help, many young Students being discouraged, have given over their Endeavours, as I my self in the Course of my Teaching have often experienced.

2dly; I have in the next Place proceeded to the Extraction of the Square and Cube-Roots, and in each

The PREFACE.

each of them have laid down all the necessary Rules; which was never so exactly done before by any one.

I have *Thirdly*, performed all Decimal Arithmetick, and have under their own Rules, shewn the Mensuration of most Figures, applicable to Superficials and Solids; I have taken in likewise Interest both Simple and Compound, to which I have also subjoined all the Tables, necessary to render the Knowledge of it Complete.

And *Lastly*, To render the Learners hereof thoroughly versed in this Art, I have inserted a Collection of pleasant and useful Questions in Vulgar Arithmetick; as also in Arithmetical and Geometrical Progression: To which I have added some practical one's in Decimals, particularly in the Extraction of the Roots, as in Military Orders, and finding out the Proportion between Solids of the same Denominations; as Globes, Cylinders, Cones, &c. and have explained what those Figures are; and what is meant by such Characters, as are used for Brevity sake in the following System; I have likewise given four useful Questions concerning gauging of Vessels, either of Wine or Beer.

Having thus laid before you a short Account of this Performance, I leave you to the Book it self, which is not set off in a florid Stile to amuse the Readers; but in a familiar and easy Method, to render it obvious and plain, even to the meanest Capacities, So wishing you Success in the Perusal, I bid you heartily

Farewel,

GIDEON ROYER.

THE

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Arith



Arithmetick.

CHAP. I.

Of Numeration.

1. **N**UMERATION is the Art of numbring well; as Magnitude or Greatness is the Subject of Geometry; Multitude or Number, is that of Arithmetick.

2. Number is that by which every Thing is set down, written, or expressed, and are written down with ten Figures, or Characters as 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, one, two, three, four, five, six, seven, eight, nine, nothing; the nine first Figures are called significant Figures.

3. The Cypher or 0, is the last, which though of itself it signifies nothing, yet being joined after any of the significant Figures, it increaseth their value, as will more fully appear by the following Table.

TABLE

B

which

Of Numeration.

which Arithmeticians therefore very properly call the Numeration Table, which at the first View, sheweth all Manner of Computation by Numbers.

The Numeration Table.

Left-hand	1	1	1	1	1	1	1	1	1	Right-hand
	2	2	2	2	2	2	2	2	2	
	3	3	3	3	3	3	3	3	3	
	4	4	4	4	4	4	4	4	4	
	5	5	5	5	5	5	5	5	5	
	6	6	6	6	6	6	6	6	6	
	7	7	7	7	7	7	7	7	7	
	8	8	8	8	8	8	8	8	8	
	9	9	9	9	9	9	9	9	9	
	C. Millions.	X. Millions.	Millions.	C. Thousands.	X. Thousands.	Thousands.	Hundreds.	Tens.	Units.	
	1	8	7	6	5	4	3	2	1	

N. B. By this Table you may perceive, how that all Arithmetick used by these numeral Figures, are to be read from the Right-hand to the Left, because 'twas the *Arabians* who first invented this Arithmetick, whose Reading is from the Right-hand towards

Of Numeration.

towards the Left; contrary to the Southern Nations.

The Explanation of the said Table.

5. Under-against every Place of the Numbers in the foregoing Table, is written (in Words at length) the Value thereof; viz. Units, Tens, Hundreds, Thousands, &c. which Words ought to be perfectly gotten by heart, and being well understood, the Learner will be the better enabled to express, or write down the Value of any Number written or named.

6. *Note*, Although this Table be made to consist but of nine Places, yet it may be continued to as many Places as you please; only observing that the Value of every Place is ten Times as much as that which goeth before it. So the tenth Place is Thousands of Millions, the eleventh Place is Tens of Thousands of Millions, the twelfth Place is Hundreds of Thousands of Millions, and the thirteenth Place is Millions of Millions; and in that Order you may conceive Places, to be continued infinitely from the Right-hand towards the Left.

7. From the Rules aforegoing, you may read, or write down any Number of Figures, that is proposed to you. As for Example, set down One thousand, five hundred, forty-nine thus, 1549, as also One hundred, twenty-three millions, four hundred fifty-six thousand seven hundred eighty-nine, thus, 123456789. And as this, so any other Number may be set down or pronounced.

Period 8. There is now (among Merchants, and Accomptants) another Method, that is very plain and useful, in the expressing of great Numbers, consisting of many Places, which is thus, first distinguished by a Comma or Point, (which may be call'd Periods) between every three Figures, reckoning in Order from the Right-hand towards the Left, viz.

Let this Number be proposed consisting of fourteen Places, viz. 84639042724536, and when every third Figure is pointed, it will stand thus, 84.639.042.724.536. every three Figures being call'd a Period, the first Period (which is 536.) viz. five hundred, thirty-six, and every other Period is to be read in every Respect, as if it stood in the first Place of the Period, only in expressing the Value of the second Place, you must add there the Word thousand; to the third Period you must add the Word Millions; to the fourth Period, Thousands of Millions; to the fifth, Millions of Millions, and so the Number before proposed, is to be read as followeth;

Eighty-four millions, of millions, six hundred thirty-nine thousand, forty-two millions, seven hundred twenty-four thousand, five hundred, thirty-six.

9. The use of a Cypher, is (by filling a Place in that Number) to augment the Value of other Figures.

10. One (or more Cyphers) in the last Place of any Number towards the Left-hand (as in these 0245, 0093, 00046) is useless, because no significant Number is thereby advanced to a more valuable Place.

11. A Cypher in any other Place adds to the Value of the Number, viz. in 2200; for by annexing these two Cyphers, they become two thousand, and two hundred; and so this Number 400301, is four hundred thousand, three hundred and one.

12. It is (by the readily learning of your Table) supposed you can set down any Number proposed, for which Purpose and Practice, I shall set down, some Numbers to make you perfect; namely, set down three-score thus, 60. Set down six-score thus, 120. Set down one thousand, seven hundred and nine thus, 1709. Again, set down eleven thousand, eleven Hundred and eleven, thus, 12111.

Of Addition

Let it be required to set down eleven millions, eleven hundred, and eleven thousand, eleven hundred, and eleven, thus 12112111, a little Practice will make you perfect.

N. B. The true setting down, the Value of any Number written or named, depends principally upon a right understanding of the three first Places in the Numeration-Table; and therefore I shall advise the Learner to be well exercised therein before he proceeds further.

Thus much as briefly and plainly I have finished *Numeration*.



C H A P. II.

Of Addition of Integers or whole Numbers.



THE Number found by Addition, is called the Sum, or total of divers Numbers put together, as 5 and 7 are 12, as also the Sum of 7, 4, and 11 put together, are 22.

2. In Addition, place the Numbers given one above another in such Sort, that like Places or Degrees in each Number, may stand in the same Rank; that is, Units under Units, Tens under Tens, Hundreds under Hundreds, Thousands under Thousands, &c.

B 3

Of Addition.

As for EXAMPLE.

What is the Sum of

457

316

245

932

764

Answer 2714

So the Numbers 457, 316, 245, 932, and 764, being given, to be added they will make the Sum 2714, or two thousand seven hundred, and fourteen.

A Second EXAMPLE.

Add 4607, 8628, 6845, 3130, being given to be added together, the Operations will stand as followeth;

1.

4607

8628

6845

3130

23210

The Operation.

The Figures in the first Rank making 20, I set down 0 under the same Rank, and carry 2 to the next Place, which makes 11, I set down 1, and carry 1 to the third Place, which making 22, I set down 2, the Excess, and carry 2 to the fourth Place; which

Of Addition

7

which said 2, and the Figures in the fourth Rank making 23, I set all down toward the Left-hand of the Figures before subscribed; so the Sum of the four Numbers given are 23210.

Number to be added are,

l.	l.	l.	l.
56	432	7100	5201
23	127	1274	1134
91	214	2901	4127
74	362	9127	7514
45	431	7216	9651
67	554	6141	6125
			2476
356	2120	33759	36228
The 300	1688	26659	31027
Proof 356	2120	33759	36228

To prove your Addition after you have added up your whole Sum, draw a Line with your Pen under the uppermost Number; and when you have so done, add all the other Numbers, except the uppermost; and when you have so done, add the Amount or Sum thereof, to the uppermost Sum above the the Line; and if that Sum be the same with the Sum first found, your work is true, otherwise not; as in those Examples before expressed.

B 4

Of

Of Addition.

Of MONEY.

WHEN the Numbers to be added together, are of divers Denominations, you must place the given Numbers in such Order, one under another, that each Rank or Degree may consist of one and the same Denomination; that is to say, if it be in Money, let Pounds be under Pounds, Shillings under Shillings, Pence under Pence, Farthings under Farthings, The like must be done in *Weights, Measure, Time, &c.*

As for *EXAMPLE.*

	<i>l.</i>	<i>s.</i>	<i>d.</i>
Let it be required to add	46	13	4
	27	17	7
	36	02	10
	10	08	9

The Sum is $121 : 00 : 1 : 0$

Thus found, I begin with Farthings first, where in I find just 8 Farthings, which is two Pence, therefore I set down 00 in the Farthings, and carry the 2 Pence to the Pence, which with the Number of Pence, as 9, 3, 7, 4, makes 25 Pence, which is two Shillings and one Penny, so setting down the 1 Penny, I carry two to the Shillings; saying, 2 that I carry and 6 is 8, and 8 and 2 is 10, and 7 is 17, and 3 is 20; so I set 0 in the Units Place of Shillings, and carry 2 Angels to the Angels Place, which with 2 Angels

Of Addition

2 Angels more, makes 4 Angels or two Pounds (an Angel is 10 s.) which said 2 l. I carry to the Pounds Place, saying 2 and 6, 7, and 6 is 21, so I set down 1, and carry 2 to the last Place of Pounds, which with 1, 3, 2, 4, makes 12. and by setting down 12 in the same Line or Rank; so the whole Work is finished, and I find the Sum to be 121 l. 00 s. or d. 00 q.

By setting down some more Examples for the Learners Practice, he may perfect himself; for by casting up these Sums in *Addition of Money*, you may learn to cast up your Bills.

	l.	s.	d.	fa.		l.	s.	d.	fa.
21	87	15	03	1		174	16	09	2
20	29	15	03	1		279	19	07	1
10	13	19	02	1		16	13	09	0
10	45	17	10	0		58	12	02	3
10	67	16	03	3		3	07	10	2
10	32	05	05	2		2	14	11	1
Sum	189	14	00	3		536	05	02	1
	159	18	02	2		361	08	04	3
Proof	189	14	00	3		536	05	02	1

To prove your Addition after you have cast up your whole Sum, draw a Line under your uppermost Number or Sum, as before directed in your *Addition of Integers*. So I proceed to *Addition of Avoir-du-pois-Weight*.

Accon-

Averdupois-Weight.

NOTE, That 16 Drains makes an Ounce,
16 Ounces is a Pound, 28 Pounds makes a
Quarter of an Hundred Weight, four Quarters is an
Hundred Weight, (consisting of 112 Pounds,) and
20 Hundred is a Tun *Avoirdupois-Weight*.

As for *EXAMPLE*.

	20	4	28		4	28	16
	C.	grs.	lb		C.	grs	lb oz.
Tuns	13	1	15	:	13	1	15 : 09
5	:	16	:	2	:	15	:
2	:	10	:	1	:	12	:
7	:	14	:	0	:	20	:
4	:	09	:	1	:	09	:
6	:	05	:	2	:	10	:
3	:	07	:	3	:	02	:
Sum	30	:	03	:	3	:	12
	24	:	07	:	0	:	25
Proof	30	:	03	:	3	:	12
	120	:	3	:	01	:	06
	107	:	1	:	13	:	13
	120	:	3	:	01	:	06

Troy

Troy-Weight.

NOTE, That 24 Grains is a Penny-weight, 20 Penny-weight is an Ounce, and 12 Ounces is a Pound Troy.

As for *EXAMPLE.*

12	20	24		12	20	24		
lb	oz.	pw.	gr.	lb	oz.	pw.	gr.	
24	: 09	: 06	: 11	30	: 11	: 12	: 16	
164	: 10	: 14	: 18	29	: 10	: 07	: 08	
82	: 07	: 17	: 20	56	: 09	: 05	: 12	
8	: 18	: 18	: 22	73	: 08	: 09	: 09	
Sum	280	: 00	: 17	: 23	191	: 03	: 14	: 21

	12	20	24
lb	oz.	pw.	gr
17	: 09	: 07	: 07
16	: 07	: 09	: 08
9	: 05	: 15	: 20
5	: 06	: 11	: 12
4	: 01	: 07	: 06
7	: 10	: 09	: 10
Sum	61 : 05	: 00	: 15

Apothecaries

Apothecaries Weight

That 20 Grains make a Scruple,
 3 Scruples one Dram, 8 Drains one Ounce,
 16 Ounces one Pound

Gr.	Dr.	Scr.	Oz.	Lb.
20	1	1	1	1
160	8	4	1	1
1280	64	32	8	1
25600	1280	640	160	10
51200	2560	1280	320	20
102400	5120	2560	640	40
204800	10240	5120	1280	80
409600	20480	10240	2560	160
819200	40960	20480	5120	320
1638400	81920	40960	10240	640
3276800	163840	81920	20480	1280
6553600	327680	163840	40960	2560
13107200	655360	327680	81920	5120
26214400	1310720	655360	163840	10240
52428800	2621440	1310720	327680	20480
104857600	5242880	2621440	655360	40960
209715200	10485760	5242880	1310720	81920
419430400	20971520	10485760	2621440	163840
838860800	41943040	20971520	5242880	327680
1677721600	83886080	41943040	10485760	655360
3355443200	167772160	83886080	20971520	1310720
6710886400	335544320	167772160	41943040	2621440
13421772800	671088640	335544320	83886080	5242880
26843545600	1342177280	671088640	167772160	10485760
53687091200	2684354560	1342177280	335544320	20971520
107374182400	5368709120	2684354560	671088640	41943040
214748364800	10737418240	5368709120	1342177280	83886080
429496729600	21474836480	10737418240	2684354560	167772160
858993459200	42949672960	21474836480	5368709120	335544320
1717986918400	85899345920	42949672960	10737418240	671088640
3435973836800	171798691840	85899345920	21474836480	1342177280
6871947673600	343597383680	171798691840	42949672960	2684354560
13743895347200	687194767360	343597383680	85899345920	5368709120
27487790694400	1374389534720	687194767360	171798691840	10737418240
54975581388800	2748779069440	1374389534720	343597383680	21474836480
109951162777600	5497558138880	2748779069440	687194767360	42949672960
219902325555200	10995116277760	5497558138880	1374389534720	85899345920
439804651110400	21990232555520	10995116277760	2748779069440	171798691840
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Of Addition

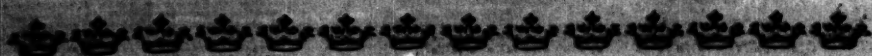
Wine-Measure

NOTE, That two Pints is a Quart, 4 Quarts a Pottle, 2 Pottles a Gallon, 4 Gallons a Tierce, or third Part of a Pipe or But, 6 Gallons is a Hoghead, 2 Hogheads is a Pipe or But, and 2 Pipes or Buts is a Tun of Wine.

As for **EXAMPLE**.

Tuns	hds	gall.	pts	Tuns	hds	gall.	pts
45	1	09	7	72	1	08	3
21	0	07	1	54	0	06	5
72	0	08	2	03	1	05	4
53	0	12	5	12	0	02	1
97	1	06	3	01	1	03	2
69	0	05	1	06	0	10	1
16	1	10	4	22	1	01	4
374	1	59	7	178	0	52	0

Note also, In *Wine-Measure*, there is esteemed or reckoned, that 8 Gallons is a Firkin of Ale, 4 Gallons is a Firkin of Beer, 2 Firkins is a Kilderkin, and 2 Kilderkins is a Barrel, 18 Gallons and a half a Runlet.



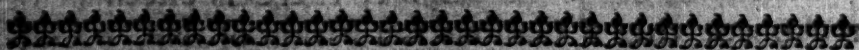
Dry-Measure.

NOTE, That 2 Pints is a Quart, 2 Quarts a Pottle, 2 Pottles a Gallon, 2 Gallons a Peck, 4 Pecks 1 Bushel *Land-Measure*, 5 Pecks 1 Bushel *Water-Measure*, 8 Bushels 1 Quarter, 4 Quarters 1 Chalder, 5 Quarters 1 Wey.

Note, That 36 Bushels is a Chaldron of Sea-Coal in London.

As for EXAMPLE.

Chald.	4	8	4	Chald.	4	8	4
	qrs.	Bush.	Pks.		qrs.	Bush.	Pks.
48	- 3	- 5	- 2	64	- 2	- 3	- 2
12	- 1	- 4	- 0	15	- 1	- 1	- 1
91	- 2	- 3	- 1	72	- 0	- 4	- 0
74	- 0	- 6	- 0	9	- 2	- 5	- 1
67	- 1	- 1	- 3	5	- 1	- 6	- 2
52	- 3	- 4	- 2	4	- 3	- 2	- 1
49	- 2	- 1	- 1	7	- 2	- 3	- 0
396	- 3	- 2	- 1	179	- 2	- 1	- 3



Long-Measure.

NOTE, 3 Barley-corns makes 1 Inch, 12 Inches 1 Foot, 3 Feet 1 Yard, 5 Yards and half a Perch or Pole, 40 Perches makes 1 Furlong, 8 Furlongs 1 *English* Mile, 1760 Yards makes a Mile.

As

Of Addition

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As for *EXAMPLE*.

	3	12	3	Miles	8	40
<i>Yards</i>	<i>Feet</i>	<i>Inch</i>	<i>Barley</i>		<i>Fur.</i>	<i>Perches</i>
326	: 2	: 10	: 1	39	: 4	: 16
127	: 1	: 09	: 0	79	: 5	: 10
414	: 2	: 07	: 1	64	: 2	: 09
732	: 0	: 11	: 0	3	: 7	: 12
256	: 1	: 01	: 2	7	: 1	: 08
514	: 0	: 10	: 1	9	: 4	: 01
937	: 2	: 03	: 0	6	: 0	: 07
3310	: 0	: 04	: 2	2	: 3	: 10
				212	: 3	: 33

Land-Measure.

NOTE, That 40 square Poles or Perches, makes a Rood, and four Roods maketh an Acre.

As for *EXAMPLE*.

	4	40
<i>Acres</i>	<i>Roods</i>	<i>Perches</i>
120	: 2	: 34
275	: 3	: 14
162	: 1	: 35
98	: 2	: 20
47	: 3	: 30
64	: 1	: 15
769	: 2	: 28

Time.

Of TIME.

NOTE, That 60 Minutes is 1 Hour, 24 Hours
1 Day and Night, 365 Days 1 Year.

The Year, by the exactest Observation of the
most excellent Mathematicians, is found to be 365
Days, 5 Hours, 49 Minutes, 4 Seconds, and 21
Thirds.

So that the Year consisteth of 365 Days, and
6 Hours; but the six Hours are reckoned
every 4th Year, and that Year is called *Leap-
Year*, so that Year *February* hath 29 Days.

	24	60
Days	Hours	Minutes
30	: 15	: 40
17	: 10	: 20
10	: 09	: 30
12	: 03	: 30

170 : 15 : 00

Note, That in this Rule of Addition, for the
Help of the Learner, I have pointed over the Head
of each Sum, where you are to make a Point; that
so by setting down the Remainder, you carry so
many Units to your next Rank on the Left-hand,
till the Sum is finished: Thus much for Addition.

80 : 0 : 00

S U B

CHAP. II.

SUBTRACTION

1. **S**ubtraction teacheth you how to take a Lesser from a Greater, whereby you may know what remaineth.

2. The Number out of which the Subtraction is to be made, must be greater, or at least equal with the other; as you may subtract 456 out of 529, but you cannot subtract 529 out of 456.

3. In *Subtraction*, rank the two given Numbers one under the other as in *Addition*, with this Caution, that the uppermost Number may exceed, or at least be equal unto the other.

4. Let it be required to subtract 4786 l. out of 5973.

First, I put down the biggest Number uppermost, viz. 5973, and place 4231 under it thus,

5973	
4231	

1742	

as you see in the Margent. Then I begin at the Right-hand, and say 1 out of 3 and there remain 2, which I set down in the same Rank under the Line. In like Manner, 3 being taken out of 7 there remain 4, which likewise I set down under the Line in the next Rank: Again, taking 2 out of 9 there remain 7, which I likewise place in the third Rank. Lastly subtracting 4 from 5 there will remain 1, which I subscribe under the fourth Rank, so the whole Operation being finished, I find that if

the 4231 be subtracted from the 5973, the Remainder will be 1742.

4231 be taken out of 5973, the Remainder is 1742, as in the Example,

$$\begin{array}{r} 5973 \\ 4231 \\ \hline 1742 \end{array}$$

More Examples of the like Nature as follow,

From	352	769	398	648
Take	121	425	134	426
Remains	231	344	264	222

5. But if the Figure which you are to subtract, be greater than the Figure out of which it is to be subtracted, then you are to borrow 10, and add it to the uppermost Figure, and then subtract the said lowermost Figure, from their Sum, and place the Remainder underneath the Line; and because you borrowed, add 1 to the next Figure in the lowermost Line, and proceed; let this be repeated as often as there is Occasion.

6. Let it be required to subtract 289 out of 478.

$$\begin{array}{r} \text{From} \quad 478 \\ \text{Take} \quad 289 \\ \hline \end{array}$$

$$\text{Remains } 189$$

I first set down those two Sums orderly one under the other, always remembring you place the greatest sum uppermost; and say 9 from 8 I cannot, but 9 from 18 refts 9, which I set down under its proper Place; then one I borrowed and 8 makes 9, and 9 from

Subtraction.

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9 from 7 I cannot, but 9 from 17 rests 8, which I set down in its proper Place: And lastly, the one I borrowed and 2 makes 3, and 3 from 4 rests 1, so the Remainder or Difference is found 189.

A few Examples of this Nature will make it understood.

A few Examples follow.

From	2510	7121	3975	2641
take	1976	4297	1986	1479
	0534	2824	1989	1162

Note, always, that where you do not borrow, you must not carry 1 as in the last Example.

For if you do not borrow of any one, you need not pay.

Next in order followeth *Subtraction of Money.*



Subtraction of Money.

IF the given Numbers consist of divers Denominations, such as *Money, Weight, Measure, Time, &c.* then you are to place the lesser Number under the greater in such Sort, that each Denomination may stand under its correspondent Name, as hath been before directed.

Then proceed to subtract the undermost Line from the uppermost, beginning at the least Denomination, and so proceed from the Right-hand towards the Left-hand, setting the Remainder under the Line till all is finished.

As for **EXAMPLE.**

Let it be required to subtract 90 *l.* 14 *s.* 10 *d.* 3 *far.* from 124 *l.* 11 *s.* 07 *d.* 1 *far.* thus:

	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>f.</i>
From	124	11	07	1
take	90	14	10	3
Rest	33	16	08	2

Thus beginning with the Farthings, I say 3 Farthings out of 1 I cannot take, wherefore borrowing 1 Penny from the next Denomination, and having converted this 1 Penny into 4 Farthings, I add them to the said 1 Farthing, so the Sum is 5 Farthings, out of which subtracting 3 Farthings, there remain 2 Farthings, which I place under the Line of Farthings; then I proceed to the next Denomination, and say, 1 Penny which I borrowed and ten makes 11, out of 7 *d.* I cannot take, wherefore borrowing 1 Shilling or 12 Pence, and adding it to the 7 Pence, the Sum is 19 Pence, from which taking the said 11 Pence there remains 8 Pence, which I set down in its due Place; again 1 Shilling which I borrowed being added to 14 Shillings makes 15 Shillings, which I cannot subtract out of 11, and therefore I borrow 1 Pound, which is 20 Shillings, which being added to the abovesaid 11 Shillings makes 31 Shillings, from which subtracting 15 Shillings, there remaineth 16 Shillings, which I place under the Denomination of Shillings, then carrying 1 Pound

Subtraction.

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1 Pound to the 0 in the Pounds Place maketh 12 which taken out of 4 there remain 3. Again, 9 out of 12 there remain 3, which being placed with its correspondent Figure 3, so that at last I find there will remain 33 l. 16 s. 08 d. 2 f.

Which is as much as to say that if A borroweth of B. 124 l. 11 s. 07 d. 1 f. and B. receiveth in Part 90 l. 14 s. 10 d. 3 f. there remains due to B. 33 l. 16 s. 08 d. 2 f.

A few Examples will make this Rule very plain.

	l.	s.	d.	f.	l.	s.	d.	f.
Recd	100	10	09	2	5109	13	05	1
Paid	67	14	10	3	3279	10	09	0

Due	32	15	10	3	1830	02	08	1
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Proof	100	10	09	2	5109	13	05	1
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Debitor	2101	12	07	1	5000	10	00	0
Creditor	1097	15	10	2	3199	14	10	2

Ballance	1003	16	08	3	1800	15	01	2
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Proof	2101	12	07	1	5000	10	00	0
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Recd	309	00	04	1	1019	12	07	1
Disburst	217	19	06	2	796	14	10	0

Rest	91	00	09	3	222	17	09	1
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Proof	309	00	04	1	1019	12	07	1
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Subtraction.

Note. If a Sum of Money be lent, and Payment thereof made at divers Times, and you would know what is due; in those Cases, you must first add up the several Payments into one Sum, and subtract that Sum from the Sum lent, and the Remainder will shew what is due. An Example or two will make it easy and plain.

Received 1240 : 14 : 07 900 : 14 : 07 : 2

Paid at fundry Times	{	300 : 10 : 05	246 : 17 : 06 : 1
		249 : 16 : 09	137 : 15 : 10 : 2
		450 : 00 : 00	256 : 14 : 06 : 0
		100 : 10 : 06	120 : 00 : 00 : 2
		50 : 00 : 08	72 : 13 : 11 : 1

Paid in all 1150 : 18 : 04 834 : 01 : 10 : 2

Due 0089 : 16 : 03 066 : 12 : 09 : 0

Proof 1240 : 14 : 07 900 : 14 : 07 : 2

Received from the Bank — 5240 : 17 : 09 : 0

Paid unto several Men per
Order, viz;

1000 : 12 : 06 : 0
500 : 00 : 00 : 0
329 : 10 : 04 : 2
715 : 11 : 06 : 0
870 : 05 : 00 : 0
600 : 00 : 00 : 0
519 : 10 : 07 : 1
450 : 00 : 00 : 0

Paid in all 4985 : 09 : 11 : 3

Remains 0255 : 07 : 09 : 1

Proof 5240 : 17 : 09 : 0

T R O T

Troy-Weight.

	12	20	24		12	20	24	
	lb	oz.	pwt.	gr.	lb	oz.	pwt.	gr.
Bought	354	: 07	: 13	: 15	172	: 09	: 14	: 11
Sold	217	: 09	: 05	: 16	97	: 06	: 17	: 09
Unfold	136	: 10	: 07	: 23	075	: 02	: 17	: 02
Proof	354	: 07	: 13	: 15	172	: 09	: 14	: 11

Another Example of Troy-Weight.

Suppose I would subtract 17 lb. 10 oz. 11 pwt. 20 gr. from 24 lb. 05 oz. 00 pwt. 8 gr. thus place your Numbers;

	12	20	24	
	lb	oz.	pwt.	gr.
	24	: 05	: 00	: 08
	17	: 10	: 11	: 20
Remains	06	: 06	: 08	: 12

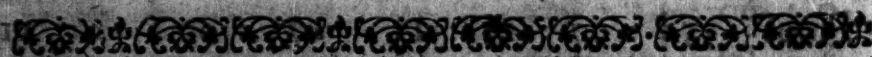
Say 20 from 8 I cannot, but borrow 1 Pennyweight which is 24 Grains, and add them to 8 and they make 32, wherefore I take 20 out of 32 there remains 12; then 1 that I borrow and 11 is 12, from 00 I cannot, but 12 out of 20 there remains 8; then 1 that I borrow and 10 is 11, from 5 I cannot, but 11 from 17 and there remains 06; then 1 that I borrow and 17 is 18, which I take out of 24 there remains 6; so that I find the Remainder or Difference

24.

Subtraction.

rence to be 6 Pounds, 06 Ounces 08 Penny-weight,
and 12 Grains.

lb	oz.	pwt.	gr.
24	: 05	: 00	: 08
17	: 10	: 11	: 20
06	: 00	: 08	: 12
24	: 05	: 00	: 08

*Avoirdupois-Weight.*

	C.	qrs.	lb	oz.		C.	qrs.	lb	oz.
From	16	: 2	: 15	: 09		32	: 1	: 19	: 10
Take	12	: 3	: 12	: 11		14	: 2	: 13	: 14
Remains	03	: 3	: 02	: 14		17	: 3	: 05	: 12
Proof	16	: 2	: 15	: 09		32	: 1	: 19	: 10

	Tuns	C.	qrs.	lb.		C.	qrs.	lb.
Bought	107	: 10	: 2	: 05		74	: 00	: 15
Sold	94	: 17	: 3	: 10		19	: 01	: 11
Unfold	12	: 12	: 2	: 23		54	: 03	: 04
Proof	107	: 10	: 2	: 05		74	: 00	: 15

A Merc

Subtraction.

25

A Merchant sells six Hodgheads of Sugar, viz.

Alloweth for Tare, viz.

marked	C.	qrs.	lb.	C.	qrs.	lb.
A. 1	32	2	19	1	3	11
B. 2	14	0	14	2	0	05
C. 3	17	3	11	2	1	17
D. 4	11	1	07	1	2	08
E. 5	09	2	09	2	1	12
F. 6	15	0	15	1	2	14

Gross 100 : 2 : 19 Tare 11 : 3 : 11

Tare 11 : 3 : 11

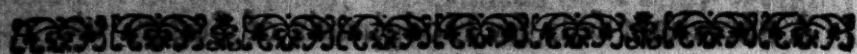
Neat 88 : 3 : 08

So that the Buyer pays for 88 C. 3 qrs. and 08 lb. neat Weight.

Liquid-Measure.

	Tuns	hdd.	gall.	Tuns	hdd.	gall.	pints
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remain	23	3	53	44	3	58	6
Proof	40	1	30	60	3	42	4

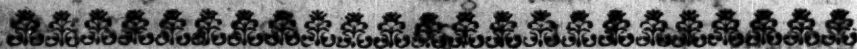
Land



Land-Measure.

	A.	R.	P.
Bought	780	2	35
Sold	90	3	36
Rest	689	2	39
Proof	780	2	35

The Proof of *Subtraction* is proved by *Addition*; for if you add the Remainder, and the Number given to be subtracted together, the Sum must be equal to the Number out of which the Subtraction is made: For if a Servant receives 50 Pound, and he lays out 37 l. 14 Shillings and Six-pence, he will have 12 Pounds, 5 Shillings and Six-pence left; for 12 Pounds, 5 Shillings and Six-pence, and 37 Pounds 14 Shillings and Sixpence is 50 Pounds. As in the Margent.



Questions to exercise Addition and Subtraction.

Quest. 1. TWO Persons *A* and *B*, have two Sums of Money; *A* hath 3456 l. and *B* 2195 l.

3456 ——— 17 s. 4 d. what is the Difference.

2195 : 17 : 4

1260 : 02 : 8

Answer, 1260 l. 2 s. 8 d.

Quest.

Subtraction.

27

Quest. 2. Two Persons are of several Ages, *A* and *B*, the Age of the Elder being that of *A*, is 65, the Difference of their Ages is 34, what is the Age of *B*?
Answer 31.

65

34

31

Quest. 3. What Number is that which being added to 248, maketh the Sum to be 309? **Answer** 61.

309

248

61

Quest. 4. A certain Person born in the Year of our Lord 1660, how old is he?
Answer 60.

1720

1660

60

Quest. 5. A Monument built in the Year 1462, how long is that since, reckoning to this present Year 1720?
Answer 258 Years.

1720

1462

258

Quest. 6. The greater of two Numbers 2400, their Difference is 1472, what is the lesser Number? **Answer** 928.

2400

1472

928



CHAP,



MULTIPLICATION.

1. **M**ultiplication teacheth you how by two or three Numbers given, to find a third or fourth, which shall contain either of the given Numbers, as many Times as the other contains 1 or Unit.
2. *Multiplication* begins at the Right-hand, and draweth (that is, multiplieth) every Figure of one Number given, into every Figure of the other Number severally; and at the last gathereth together the several Products into one Sum, having diligent care to place them in their due Places.
3. In *Multiplication* note, the Multiplicand, the Multiplier, and the Product.
4. The Multiplicand is the Number given to be multiplied, and is usually for Methods Sake, the greatest of the two given Numbers.
5. The Multiplier is that by which the Multiplicand is multiplied, and is usually the least Number.
6. The Product is the Number arising by the Multiplication, and it containeth the Multiplicand as often as the Multiplier containeth Units.
7. The Work of Multiplication is contained in the following Table, which must be learn'd by heart, before the Learner can make any considerable Progress.

The Table of Multiplication usually called
Pythagoras's Table.

1	2	3	4	5	6	7	8	9
—	—	—	—	—	—	—	—	—
2	4	6	8	10	12	14	16	18
—	—	—	—	—	—	—	—	—
3	6	9	12	15	18	21	24	27
—	—	—	—	—	—	—	—	—
4	8	12	16	20	24	28	32	36
—	—	—	—	—	—	—	—	—
5	10	15	20	25	30	35	40	45
—	—	—	—	—	—	—	—	—
6	12	18	24	30	36	42	48	54
—	—	—	—	—	—	—	—	—
7	14	21	28	35	42	49	56	63
—	—	—	—	—	—	—	—	—
8	16	24	32	40	48	56	64	72
—	—	—	—	—	—	—	—	—
9	18	27	36	45	54	63	72	81

7. The Use of this Table is thus : Find the two Units given to be multiplied together, one in the upper Column of the Table, and the other in the first Column of the Left-hand ; This done in the Angle of Position, just against those two Figures, you shall find the Product. Thus the Table shews you that 5 times 9 is 45, 6 times 7 is 42, 7 times 8 is 56, and 9 times 8 is 72, and so of the rest.

8. Simple *Multiplication* is, when the Multiplicand and Multiplier consist each of them of one only Figure, as in this Example.

As if it were required to multiply 458 by 6, I set them down as followeth :

The

Multiplication.

The Multiplicand 458

The Multiplier 6

The Product 2748

Thus I say, 6 times 8 is 48, which being 8 above 4 tens, I set down 8, and go 4 to the next Place ; then I proceed, saying, 6 times 5 is 30, and that 4 that I carry is 34, which 4 I set down in the Line and carry 3 ; saying 6 times 4 is 24, and 3 I carry is 27, I set it all down, and so the Sum is finished, I find that 6 times 458 is 2748.

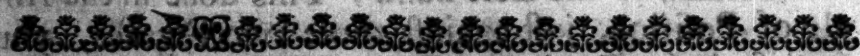
Other Examples in this Rule for Practise may be such as follow.

Multiplicand	7946	5347	2480	5100
Multiplier	5	6	7	8

Product	39730	32082	17360	40800
---------	-------	-------	-------	-------

Multiplicand	3721	4001	2701	51007
Multiplier	9	4	3	10

Product	33489	16004	8103	510070
---------	-------	-------	------	--------

*Compound Multiplication.*

9. **C**ompound Multiplication is, when the Multiplier and Multiplier, either one or both, consist of more Figures than one.

10. When the Product of any of the particular Figures exceeds ten, place the Excess under the Line, as before taught ; and for every ten that it so exceeds,

Multiplication.

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exceeds, keep it in Mind to be added to the next Rank.

E X A M P L E.

Let it be required to multiply 3084 by 36, the Work will stand thus:

For 6 times 4 is 24 I write 4 under the Line, and reserve 2 in Mind for the two Tens; then I say, 6 times 8 is 48, unto which if I add 2 kept in Mind, the whole is 50, wherefore, saying, 6 times 0, is nothing, but the 5 I carried in Mind is 5, which is likewise set under the Line in the next Rank; again, 6 times 3 is 18, which I write wholly down, so that the particular Product arising from the multiplying Figure 6, is 18504. In like Manner proceeding with the multiplying Figure 3, the particular Product arising will be 9252. Lastly, these several Products being placed in due Order, and added together will give 111024, which is the total product arising from the *Multiplication* of 3084 by 36, as by the Operation above appeareth.

$$\begin{array}{r}
 3084 \\
 36 \\
 \hline
 18504 \\
 9252 \\
 \hline
 111024
 \end{array}$$

In like Manner multiply 52467 by 354

$$\begin{array}{r}
 52467 \\
 354 \\
 \hline
 209868 \\
 262335 \\
 157401 \\
 \hline
 18573318
 \end{array}$$

Again;

Multiplication.

Again, multiply 5974623475
By 67438

47796987800
17923870425
23898493900
41822364325
35847740850

402916657907050

11 When there is one or more Cyphers in the Multiplier betwixt significant Figures:

As for Example.

45793 8465008
507 4006

320551 50790048
2289650 3386003200

23217051 33910822048

When in the Multiplier Cyphers are included between significant Figures, multiply by the said significant Figures, neglecting such Cyphers; but observe diligently to set the particular Products of the significant Figures in their due Places.

More

Multiplication.

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More Examples are these that follow.

$$\begin{array}{r} 43100 \\ 15000 \end{array}$$

$$\begin{array}{r} 2155 \\ 431 \end{array}$$

$$\begin{array}{r} 646500000 \end{array}$$

$$\begin{array}{r} 1 \\ 8465008 \\ 4006 \end{array}$$

$$\begin{array}{r} 50790048 \\ 3386003200 \end{array}$$

$$\begin{array}{r} 33910822048 \end{array}$$

$$\begin{array}{r} 2 \\ 7645932 \\ 48000 \end{array}$$

$$\begin{array}{r} 61167456 \\ 30583728 \end{array}$$

$$\begin{array}{r} 367004736000 \end{array}$$

You may multiply by the significant Figures, as in the second Sum, and afterwards annex as many Cyphers as there are Cyphers in the Multiplier.

$$\begin{array}{r} \text{Again, multiply} \\ \text{By} \end{array} \begin{array}{r} 74965 \\ 1500 \end{array}$$

$$\begin{array}{r} 374825 \\ 74965 \end{array}$$

$$\begin{array}{r} 112447500 \end{array}$$

D

When

When either the Multiplier or Multiplicand consisteth only of an Unit, and one or more Cyphers, annex the Cyphers to the other Number, and the Work is done ; as in these Examples.

$$\begin{array}{r} 7412 \\ 100 \\ \hline 741200 \end{array}$$

$$\begin{array}{r} 10000 \\ 425 \\ \hline 4250000 \end{array}$$

$$\begin{array}{r} 4000 \\ 20 \\ \hline 80000 \end{array}$$

P R O O F.

The Proof of *Multiplication* as is commonly used, is by casting away the 9's out of the Multiplicand, Multiplier, and Product : But this Proof being very erroneous, as is evident to all such as know the Rule, I shall therefore forbear shewing that Method, by Reason, the true Proof of *Multiplication* is by *Division*, and *Division* by *Multiplication* ; for as *Multiplication* encreaseth, so *Division* decreaseth, as hereafter will more fully appear.

Note, That one of the principal Caution's to be observed in *Multiplication*, is the due placing of the particular Products, by each multiplying Figure ; and that is performed by taking care to place your Figures strait one under another.



D I V I

CHAP. V. DIVISION.

1. **D**IVISION, is that by which we discover how often one Number is contained in another.

2. In *Division* there are always three remarkable Numbers, which are commonly called by these Names, *viz.*

The *Dividend*,
The *Divisor*,
And the *Quotient*.

3. The *Dividend* is the Number given to be divided into equal Parts.

4. The *Divisor* is the Number by which the *Dividend* is to be divided; that is, it is the Number, which sheweth into how many equal Parts the *Dividend* must be divided.

5. The *Quotient* is the Number, which discovers how often the *Divisor* is contained in the *Dividend*, which is the Number produced by the *Division*; so if 40 were to be given to be divided by 8, the Number produced would be 5.

Dividend
Divisor 8) 40 (5 Quotient

40

—

0

D 2

Divi

6. *Division* being the hardest Rule in *Arithmetick*; must be diligently and carefully minded by the Learner; for whose sake I shall use the utmost of my Judgment, to make the Way smooth and easy by Rules and Examples, beginning with the easiest first, which will be in that Case, when the Divisor consists of one Figure only; as for Example:

Let it be required to divide 88 by 4, first write down the Dividend, and then draw a crooked Line, and place the Divisor on the Left-hand thereof, then draw a Line under the Dividend: Thus,

$$\begin{array}{r} \text{Dividend} \\ \text{Divisor } 4 \overline{) 88} \quad (22 \text{ Quor.} \\ 8 \end{array}$$

$$\begin{array}{r} 08 \\ 8 \\ \hline 0 \end{array}$$

7. *Note*, That in every Division you must observe this Method; First, To ask how many. Secondly, Multiply. Thirdly, Subtract.

The Operation of this last Sum, I will unfold for the better understanding: Thus, having placed a crooked Line at each End of the Dividend, that on the Left-hand for the Divisor, and that on the Right-hand for the Quotient; then if the Divisor be a single Figure, subscribe a Point under the first Figure of the Dividend towards the Left-hand and ask how often the Divisor 4 is contained in the Dividend 8, the Answer is found 2, wherefore I write 2 in the Quotient; then multiplying the Divisor 4 by 2 (the Number placed in the Quotient) the Product is 8, which I subscribe orderly under the Dividend 8; and after a Line is drawn underneath the Product, I subtract it from the Dividend 8, and place the Remainder 0 underneath the Line. Then

Division

37

Then proceed and put another Point under the next Place of the Dividend towards the Right-hand, and bring down the Figure, or Cypher standing in that Place to the Remainder ; that is, set it next after it, so the whole will be a new Dividial : Thus a Point being place under the other 8, I write down 8 next after 0, to wit, on the Right-hand of the Remainder 0 ; so is 8 a new Dividial or Number, whereof the second Question must be asked, and the Work will stand thus :

$$\begin{array}{r}
 4 \overline{) 88} \begin{array}{l} 22 \\ 8 \cdot \cdot \end{array} \\
 \underline{8} \\
 08 \\
 \underline{8} \\
 0
 \end{array}$$

9. A new dividial being brought down which is 8, renew the Question by asking how often 4 is contained in 8, the Answer is 2, wherefore I write 2 in the Quotient; then multiplying the Divisor 4 by 2, the Product is 8, which I subscribe under the Dividial 8; and after a Line is drawn, I subtract the Product 8 from the Dividial 8, and there being no Remainder, I subscribe 0 under the Line: So the whole Work is finished, the Quotient is found 23, and the Operation stands as you see in the Margent; wherefore I say, That if 88 Pound were to be divided amongst 4 Persons, the Share of each Person will be 22 Pounds.

$$\begin{array}{r}
 4 \overline{) 88} \begin{array}{l} 22 \\ 8 \cdot \cdot \end{array} \\
 \underline{8} \\
 08 \\
 \underline{8} \\
 0
 \end{array}$$

A second EXAMPLE.

Let it be required to divide 7425 amongst 6 Persons. Thus,

$$6 \overline{) 7425} (1237 \text{---} \frac{3}{2}$$

6

14

12

22

18

45

42

3

This last Example by working it according to the last Question you will find, that if a Man died worth 7425 Pounds to be distributed amongst 6 Children, their Shares will be found to be 1237 Pounds, and there will be an Overplus of 3 Pounds remaining, which by Reason the Remainder 3 is half the Divisor 6, it is therefore 10 s. more; so that every Child must have 1237 l. 10 s. 00 d. apiece: But how the before mentioned Fraction 3, on any other Remainder after your Division is finished, will be taught in the next Rule of Reduction following.

Various

Various Examples for Practice.

8)9640(1205	9)7113(790	3)548(182
8...0	63...	3...
16	81	888
16	81	24
040	03	184
40	0	24
0	3	08
		6

10. When the Divisor consists of two, or three, or how many Places soever, the Operation is more difficult than the former, though it depends upon the same Grounds; and therefore the Learner being well vers'd in dividing by a single Figure, he will understand these that follow, which are two, whereof the first is the easier, but the latter more expeditious, and that which indeed is principally to be learned: For an Example of the former;

Let it be required to divide 896487 by 648, or which is all one, to divide 896487 into 648 equal Parts.

First a Table is to be made, to shew at first Sight any Product of the Divisor, it being taken twice, thrice, or any Number of times under ten, so having written down the Divisor itself 648; and drawn a Line on the Right-hand thereof, I place 1 on the Right-hand of the Line directly against the Divisor; then underneath the Divisor 648, I subscribe the double thereof which is 1296, and place the Figure 2 directly against the Divisor; then underneath

D 4

the

Multiples of the Divisor,	Divisor 648	1	the Divisor 648, I subscribe the
	1296	2	Double thereof, which is 1296, and
	1944	3	place the Figure 2 directly against
	2592	4	the said Double on the other Side
	3240	5	of the Line : Again, by multiply-
	3888	6	ing the Divisor 648 by 3, the
	4536	7	Sum is 1940, this Triple I sub-
	5184	8	scribe under the Double, and place
	5832	9	3 on the other Side of the Line

right against the Triple; and so proceeding in like Manner with the Quadruple, Quintuple, Sextuple, Septuple, Octuple, and Non-cuple of the Divisor.

Now for a Proof of the said Table, adding the last Number thereof, to wit 5832, which was found to be 9 times the Divisor to the Divisor 648, I find the Sum to be 6480, which is ten Times the Divisor, as you may see in the Margent; wherefore I conclude the Table is true, because the last Number thereof is derived from all the superior Numbers.

The Table being thus prepared, write down the Dividend, on the Right-hand of the Divisor; then distinguish by a Point, so many of the foremost Places of the Dividend towards the Left-hand, as are either equal in Value to the

648		5976472(9222	Divisor, or which being
1296		5832....	greater, yet come nearest
1944	3	—	to the Value thereof, thus
2592	4	1444	I subscribe a Point under
3240	5	1296	6, thereby setting apart
3888	6	—	5976 being the fewest of
4536	7	1487	the foremost Places which
5184	8	1296	will contain the Divisor
5832	9	—	648; so is 5976 the Di-
		1912	vidual (or Number where-
		1296	of the first Question must
		—	be asked,) then demand-
		616 Rem.	ing how often the Divisor
		—	

648 is contained in the Dividual 5976, the Answer will be found in the Table to be 9 Times; for looking in the Table, I cannot find the Dividual exactly, but I see that 9 Times, to wit 5832 is the next Letter, wherefore I write 9 in the Quotient, and the Number in the Table which stands against 9, to wit 5832, I subscribe under the Dividual 5976; then having drawn a Line underneath, I subtract 5832 from the Dividual 5976, and subscribe the Remainder 144 underneath the Line: That done I put a point under the next Place of the Dividend towards the Right-hand, which I find to be 4, I subscribe it after the Remainder 144, so there is 1444 for a new Dividend.

Then demanding how often the Divisor 648 is contained in the Dividual 1444, the Answer will be found by the Tables to be 2 times, wherefore I write 2 in the Quotient, and the Number in the Table which stands against 2, to wit 1296 I subscribe under, and subtract from the Dividual 1444, and there remains 148, which I place underneath the Line.

Again, I put a Point under the next Place of the Dividend, where I find the Figure 7; and therefore transcribing 7 next after the Remainder 148, the new Dividual will be 1487; then demanding how often the Divisor 648 is contained in the Dividual 1487, I find it 2 times contained therein, and wherefore I write 2 in the Quotient, and the Number in the Table is 1296, which I subscribe under 1487, and then there will remain 191, which I place under the Line.

Again, I put a Point under the next Place of the Dividend where I find the Figure 2, and therefore transcribing 2 next after the Remainder 191, the new Dividual will be 1912; then demanding how often the Divisor 648 is contained in the Dividual 1912, I find it again 2 times, which I write down

in

in the Quotient; viz. 1296, which I subscribe under 1912, and then there will remain 616; wherefore I conclude, that if 5976472 be divided by 648, the Quotient will be 9222, and a Remainder of 616, thus commonly set $9222 \frac{616}{648}$.

In like Manner to divide a greater Number this Way, viz. 9120165347 by 2978, the Quotient arising will be,

$$\begin{array}{r}
 2978 \overline{) 9120165347} \quad (3062513 \frac{1633}{2978} \\
 \underline{5956} \\
 8934 \\
 \underline{11912} \\
 14890 \\
 \underline{17868} \\
 20846 \\
 \underline{23824} \\
 26802 \\
 \underline{15293} \\
 14890 \\
 \hline
 \end{array}$$

4034

2978

10567

8934

1633 Remainder.

Proof of the Table.

$$\begin{array}{r}
 26802 \\
 2978 \\
 \hline
 29780
 \end{array}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{is equal to 10 times the Divisor.}$$

2978

10

29780

The

The Preceding Method of *Division*, by the Help of a Table of the *Multiplies*, or *Product* of the *Divisor*: As it is most easy, so in some Cases, namely, where the *Divisor* is great, and a *Quotient* of many Places is required; it excels all other Ways of *Division*, both in Respect of *Certainty* and *Expedition*. But for common Practice it is too tedious, and therefore I shall proceed to the practical Method.

11. I now come to the last and principal Method of *Division*, which to such as have the Table of *Multiplication* by Heart, it will not be difficult.

Division by two or more Figures, being the hardest Lesson in *Arithmetick*, must be carefully minded.

12. When the *Divisor* consisteth of more Places than one, then you are to set out so many Figures on the Left-hand of the *Dividend* for a *Dividual*, and then put a Point under that Figure of the *Dividual*, which stands next to the Right-hand.

Then seek how often the first Figure towards the Left-hand of the *Divisor*, is contained in the first Figure towards the Left-hand of the said *Dividual*, and place the Answer in the *Quotient*.

Then multiply the whole *Divisor* by the said Figure, so placed in the *Quotient*, and place the *Product* in order under the *Dividend*.

Which being done, subtract the said *Product* from the *Dividual*, placing the *Remainder* under the Line.

Then put a Point under the next Figure of the *Dividend*, and annex it to the *Remainder*, so you have a new *Dividual*, in which you are to proceed as shall be directed.

As for EXAMPLE.

Let it be required to divide 8904 by 42, here the given Number being disposed of according as before directed, will stand as followeth;

$$42 \overline{) 8904}$$

Then because there are 2 Places in the Divisor, by Consequence you must take the first two Figures on the Left-hand of the Dividend for a Dividual which is 89, putting a Point under the 9.

Then I seek how often the first Figure 4 is contained in the first Figure 8, the Answer is 2 times, wherefore I multiply 2 in the Quotient by 42, the Divisor, and the Product is 84, which I transcribe directly under 89 and subtract it, and there will remain 5.

Then I put a Point under the next Place which is 0, and annex it to the Remainder 5, and it makes 50 for a new Dividual, and the Work will stand as followeth:

$$\begin{array}{r} 42 \overline{) 8904} \quad 21 \\ \underline{84} \\ 50 \\ \underline{42} \\ 8 \end{array}$$

Then I seek how often I can have 4 in five, and the Answer is 1, wherefore I put 1 in the Quotient, and multiply the Divisor 42 by 1, which makes 42, which I place under 50, and subtract it from 50 and there will remain 8, which I place in order under the Line, and thereto annex the next Figure of the Dividend which is 4, and then it makes 84 for a new Dividual, and then the work will stand as followeth:

Division.

45

$$42 \overline{) 8904} (212$$

$$\underline{84}$$

$$50$$

$$\underline{42}$$

$$84$$

$$\underline{84}$$

$$0$$

Then Lastly, seeking how often 4 is contained in 8, and the Answer is 2 times, wherefore I put 2 in the Quotient, and thereby multiply the Divisor 42 by 2, which makes 84, and by subtracting 84 from 14 the Remainder is 0, and so the Operation is ended: So that if I divide 8904 Pounds amongst 42 Persons, each Person must have 212 Pounds.

13. *Note*, That whensoever the Product of the *Multiplication* by the Divisor, is greater than the Dividual from which it ought to be subtracted, such Product must be struck out, and a lesser Figure is to be placed in the Quotient: For you cannot subtract a greater Number from a lesser

A Second EXAMPLE.

Let it be required to divide 8425796 by 365, the work will stand thus :

$$365)8425796(23084-\frac{136}{365}.$$

730

1125

1095

3079

2920

1596

1460

136

The Answer is 23084— $\frac{136}{365}$, that is to say, as 136 is to 365. Which what the Remainder is in Money will be shewn to you in the next Rules following.

A third

A third EXAMPLE.

14. Let it be required to divide 4763585 by 587.
The Work will stand thus:

$$\begin{array}{r}
 587 \overline{) 4763585} \quad (8115 \text{ --- } 80 \text{ --- } 80 \\
 \underline{4696} \\
 675 \\
 \underline{587} \\
 888 \\
 \underline{587} \\
 3015 \\
 \underline{2935} \\
 80 \text{ Remainder.}
 \end{array}$$

In this Question, because the Divisor 587 is bigger than the Dividual 476, I therefore put my Point to 3, then the Dividual becomes 4763, from which taking the Divisor 587 out of the Dividual, I find it 8 times (for 9 times is too much) so placing 8 in the Quotient, and having multiplied the Divisor thereby which is 4696, and subtracting it out of 4763, the Remainder is 67, to which by putting a Point to 5; then I have 675 for a new Dividual, and so proceeding according as before taught, your Quotient will be 8115, and 80 for a Remainder. See the Work.

Fourth

Fourth EXAMPLE.

Let it be required to divide 7910010295 by 59746.
Thus,

59746)	7910010295	(132393	38117
59746		59746	39746
<u>193541</u>			58117
179238			794358
<u>143030</u>			529572
119492			926751
<u>235382</u>			1191537
179238			661965
<u>237355</u>			
179238			
<u>58117</u>			
			Remainder.

15. This latter Method of *Division* is to be preferred before any of the common Ways of dividing by dashing out of Figures, where the Steps of the Division are so confounded by a promiscuous Multiplication and Division, that if any Error happens, it can scarce be corrected without beginning the Work a new : But in this Way before explained, the particular Multiplications, Subtractions and Remainders, which belong to every Figure of the Quotient, are so distinctly and clearly set down, that if an Error happen, it may easily be reformed.

In

Division.

49

In like Manner if you divide 4926735806877 by 5846793, the Quotient will be 842639, and the Remainder will be 150, and the Work will stand as here you see.

$$5846793 \overline{) 4926735806877} \quad \begin{array}{r} 842639 \\ 150 \end{array}$$

$$46774344 \dots$$

$$24930140$$

$$23387172$$

$$15429686$$

$$11693586$$

The Proof of this Question is on the other Side.

$$37361008$$

$$35080758$$

$$22802507$$

$$17540379$$

$$52621287$$

$$52581137$$

150 Remainder.

16. You must note, That as many Points as you have in the Dividend, so many Figures you must have in the Quotient : As in this Example you have 6 Points in the Dividend, and you have 6 Figures in the Quotient.

17. The Proof of *Multiplication* and *Division*, do interchangeably prove one another ; for in *Division*, if you multiply the Divisor by the Quotient, and add in the Remainders if there be any, the Product will be equal to the Dividend, as you shall find

E

in

in this Example of 4926735806877 divided by 5846793:

Divisor	Dividend	Quotient.	Rem.
Thus 5846793)	4926735806877	(842639	150

P R O O F.

$$\begin{array}{r}
 5846793 \\
 842639 \\
 \hline
 52621137 \\
 175403790 \\
 353807585 \\
 116935861 \\
 23387172 \\
 46774344 \\
 \hline
 4926735806877
 \end{array}$$

There is also of *Multiplication* and *Division* a common Proof, by casting out the 9's, but by that Way of Proof, (though rightly used) a false Product will be affirmed to be true, as is manifestly known to such as know the Rule, which is mentioned in *Wingate's Arithmetick*, to set a Brand upon it, that it may be avoided by all Lovers of Truth.

And for this Reason I have totally avoided the shewing of the Method of casting away the Nines.

Compendiums in Division.

Many Times the Work of *Division* may be much shortened.

1. If the Divisor has one or more Cyphers on the Right-hand, cut off so many Figures on the Right-hand of the Dividend, as there are Cyphers on the Right-

Division.

51

Right-hand of the Divisor, and divide the remaining Figures of the Dividend, by the remaining Figures of the Divisor, and to the Remainder annex those Figures cut off from the Dividend, and the Quotient will be 116, and the Remainder 258; as in this Example.

Let it be required to divide 46658 by 400, see here the Work.

$$400 \overline{) 46658} (116$$

4

06

4

26

24

258

Divide 4572 by 20, thus $457 \overline{) 2}$

228 | 12

O R

$$20 \overline{) 4572} (228$$

4

05

4

17

16

12 Remainder.

E 2

$$20 \overline{) 715}$$

35 | 15

Again,

$$20 \overline{) 2790}$$

139 | 10

Again, divide 4720 Pounds amongst 10 Persons, the Share of each would be 472 *l*.

$$1|0)472|0(472$$

Also among 100 Persons the Share of each would be 47 *l*.

$$1|00)47|20(47 \text{ and a Remainder of } 20$$

Lastly, If the said 4720 Pounds, were to be divided amongst 1000 Persons, the Share of each would be 4 *l*. and a Remainder of 720, to be also divided. See the Work as above.

$$1|000)4|720(4 \text{ l.}$$

Another EXAMPLE.

Divide 486783 by 15000 ; first I cut off the three Cyphers of the Divisor, and also three Places of the Right of the Dividend, so you have 15 for Divisor, and 486 for my Dividend.

$$15|000)486|793(32$$

45

36

30

6 Remainder.

For the better understanding of these Abbreviations by Cyphers, I shall insert some more Examples, both mixt and otherwise.

Divide 7456787 by 304000, the Quotient will be 24, and there will remain 160787, viz. if you cut off 3 Places from the Dividend toward the Right-hand (3 Places, because the Divisor ends with 3 Cy-

Division.

53

3 Cyphers) and then divide 7456 by 304, there will arise in the Quotient 24, and the Remainder will be 160, unto which if 787 be annexed, the total Remainder or Surplusage is 160787, which what it is in Value will appear better in the preceeding Rules. See the Operation.

$$304 \overline{) 10007456} 787 (24$$

$$\begin{array}{r} 608 \\ \hline 1376 \\ \hline 1216 \end{array}$$

160

The Remainder, to which adding 787, the total Remainder is 160787, as above taught.

Again, Divide 486783 by 15000 thus,

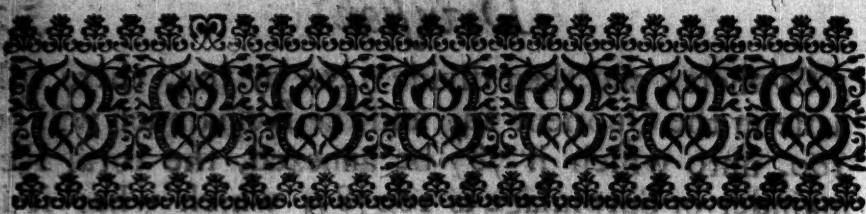
$$15 \overline{) 1000486} 793 (32$$

$$\begin{array}{r} 45 \\ \hline 36 \\ \hline 30 \end{array}$$

6

to which adding 793, it makes the true Quotient $32 - \frac{6793}{150000}$.

Having thus done, enlarged, and finished the 5 principal Parts of *Arithmetick*, upon the right understanding whereof, all the following Rules, and all other Operations whatsoever, wrought by Numbers, do immediately depend; I would therefore advise the Learner to be thoroughly instructed before he proceeds to the following Chapters.



CHAP. VI. Of REDUCTION.



REDUCTION teacheth you how to bring a greater Number into a lesser, and a lesser into a greater.

2. *Reduction* is either *descending* or *ascending*.

3. *Reduction-descending* is, when you are to bring Greater into a Lesser, as Pounds into Shillings, Shillings into Pence, Pence into Farthings, and so consequently of all other great Denominations into Lesser, performed by *Multiplication*.

4. *Reduction-ascending* is, when you bring a Lesser Number into a Greater, as Farthings into Pence, Pence into Shillings, Shillings into Pounds, and so of the rest, and this is performed by *Division*.



Of MONEY.

EXAMPLE I.

Descending.

1. **I** Would know how many Farthings there are in 564 Pounds.

564
20

11280 Shillings.
12

22560
11280

135360 Pence.
4

541440 Farthings.

Thus if 564 Pounds be multiplied by 20, the Product is 11280 Shillings, in like Manner 11280 Shillings will be reduced into Pence by 12, and the Product is 135360 Pence, which being multiplied by 4, the Product is 541440 Farthings.

EXAMPLE 2.

Ascending.

2. In 541440 Farthings how many Pounds.

This Question is the reverse of the former, and may serve for a Proof; by *Division*.

$$\begin{array}{r}
 12 \quad 20 \\
 4 \overline{) 541440} \quad 12 \overline{) 135360} \quad 20 \overline{) 11280} \\
 \underline{4} \quad \quad \quad \underline{12} \quad \quad \quad \underline{20}
 \end{array}$$

564 Pounds,

$$\begin{array}{r}
 14 \quad 15 \\
 12 \quad 12
 \end{array}$$

$$\begin{array}{r}
 21 \quad 33 \\
 20 \quad 24
 \end{array}$$

$$\begin{array}{r}
 14 \quad 96 \\
 12 \quad 96
 \end{array}$$

$$\begin{array}{r}
 24 \quad 00 \\
 24 \quad \underline{\quad}
 \end{array}$$

$$\begin{array}{r}
 00 \\
 \underline{\quad}
 \end{array}$$

Which answers directly 564 l.

Of bringing Shillings into Pounds, always cut off the last Figure and halve it.

$$2 \overline{) 011280}$$

564

Of Reduction.

57

EXAMPLE 3.

3. In 549 : 17 : 6 : 3 how many Farthings.
20

10997 Shillings.
12
22000
10997
131970 Pence
4
527883 Farthings.

Multiply by 20, and take in your 17 Shillings and the Product is 10997, Shillings, which being multiplied by 12 the Product is 131970 Pence by taking in the 6, which Product of Pence being multiplied by 4, and take in your 3 Farthings, the Answer is 527883 Farthings.

EXAMPLE 4, or Proof.

4. In 527883 Farthings how many Pounds.
12)

4)527883(131970(1099|7

4.....12.....
549-17-6-3 farth.

12	119
12	108
07	117
4	108
38	90
36	84
28	6
28	
03	

Avoir-



Avoirdupois-Weight.

Example 1. **I**N 27 : 2 : 13 : 9 how many Ounces.

4

110 Quarters.

28

883

221

3093 Pounds.

16

18567

3093

49497 Ounces.

The P R O O F.

Example 2. In 49497 Ounces, how many Hundred Weight.

28) 4) C. qrs. lb. oz.
16) 49497 (3093 (110 (27—2—13—09
48... 28... 8...

149

29

30

144

28

28

2 Quarters.

57

13 Pounds.

48

9 Ounces.

EX-

Of Reduction.

59

EXAMPLE 3.

In 795109 Ounces of Pepper, how many Hundred Weight.

$$\begin{array}{r} 28 \quad 4 \quad C. \quad qrs. \quad lb \quad oz. \\ 16 \overline{) 795109 (49694 (1774 (443 : 2 : 22 : 5} \\ \underline{64} \dots \quad \underline{28} \dots \quad \underline{16} \dots \end{array}$$

$$\begin{array}{r} 155 \quad 216 \quad 17 \\ \underline{144} \quad \underline{196} \quad \underline{16} \end{array}$$

$$\begin{array}{r} 111 \quad 209 \quad 14 \\ \underline{96} \quad \underline{196} \quad \underline{12} \end{array}$$

$$\begin{array}{r} 150 \quad 134 \quad 2 \text{ Quarters} \\ \underline{144} \quad \underline{112} \end{array}$$

$$\begin{array}{r} 69 \quad 22 \text{ Pounds.} \\ \underline{64} \end{array}$$

$$\begin{array}{r} 5 \text{ Ounces.} \\ \underline{\quad} \end{array}$$

PROOF.

Now GROSS is the Weight of any Common
dry, with the Heads, Casks, Chells,
Tubs, and other Sorts of Goods.
Tare is the Allowance for the Weight of
the Cask, Hogshead, Chells, &c.

PROOF

Nett Weight

Of Reduction.

P R O O F.

C. qrs. lb. oz.

Example 4. In 443 : 2 : 22 : 5 how many Ounces.

4

1774 Quarters.

28

14194

3550

49694 Pounds.

16

298169

49694

795109 Ounces.

Example 5. In 4 Chests of Sugar each weighing
7 C. 3 qrs. 12 lb. Gross, how many lb Neat.

C. qrs. lb.

7 : 3 : 12

4

31

28

250

63

880 Pounds.

4 Chests.

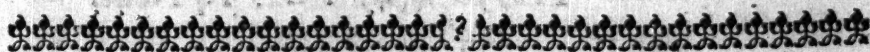
3520 Pounds in all.

P R O O F.

P R O O F.

$$\begin{array}{r}
 28) 4) \text{ C .qrs. lb.} \\
 4) 3520(880(31(7 : 3 : 12 \\
 \underline{32} \quad \underline{84} \quad \underline{28} \\
 32 \quad 40 \quad 3 \text{ Quarters.} \\
 \underline{32} \quad \underline{28} \\
 00 \quad 12 \text{ Pounds.}
 \end{array}$$

I do not question but by the Understanding of the foregoing Examples, the Learner is sufficiently instructed in the proving of any Sum in *Reduction*. My Design being not to trouble myself any more with the Proofs; but the rather to go forward with Matters more useful, and so I shall proceed with some Examples of *Tret* and *Tare*, *Cloth-Measure*, and other Examples in order.



Of Tret and Tare.

Note, **G**R O S S is the Weight of any Commodity, with the Hogheads, Casks, Chests, or whatsoever else contains the Commodity.

Tret is an Allowance of 4 Pounds in the 104 Pounds, allowed by the Merchants of *London*, for Waste and Dust on some Sort of Goods.

Tare is the Allowance given for the Weight of the Cask, Hoghead, Rapper, &c.

As

As for *EXAMPLE.*

Quest. In 48 : 3 : 14 Tare, 3 : 3 : 17 how many Pounds Neat.

C. qrs. lb.
48 : 3 : 14 Gross.
3 : 3 : 00 Tare deducted.

45 : 0 : 14 Remains.
4

180 Quarters
28
1444
361

5054 Pounds neat.

C. qrs. lb.
112)5054(45 : 0 : 14 Neat.
448

574
560

14

Which Pounds neat being divided by 112 gives you 45 : 0 : 14 Neat Weight.

Quest.

Of Reduction.

63

Quest. 2 In 145 : 2 : 16 Tare 14 per Hundred,
Tret 4 Pounds per 104, how many Pounds neat.

C.	qrs.	lb.	C.	qrs.	lb.
145	: 2	: 16	145	: 2	: 16
4			14		
582	Quarters		580		
28			145		
4662			2030		
1165			9	Allowed for	
16312	lb Subtle.	2039	the 2 Quart.		
2039	lb Tare.		and 16.		

14273 Remainder.

627 lb Tret 26) 16312 (627 lb Tr

156...
13646 lb Neat.

OR the Pounds Neat being
divided by 112 makes 121 C.
3 qrs. 10 lb. Neat Weight.

71

52

192

182

10

I divide the Pounds
by Subtle by 26, because
4 lb. is the 26th of 104,
(the Allowance always
given for Tret.)

C. qrs. lb.
112) 13646 (121 : 3 : 10

112...

244

224

206

112

lb. qrs. lb.
94 is equal to 3 : 10

94 C. 3 qrs. 10 lb

Quest. 3.

Quest. 3. In 3 Bags of Pepper weighing Gross
34 C. 3 qrs, 16 lb. Tare 12 lb. per Bag, and Tret
4 lb. per 104, how many Hundred Weight Neat.

C.	qrs.	lb.	t.
34	3	16	12
4			3 tare.

139	36 p. bag
28	

1118
279

3908 lb Subtle.

36 lb Tare. p. Bag.

3872 lb Gross.	26)	3872 (148
148 Tret.		26...

3724 — Neat.	127
	104

232
208

24

Or 112)3724(33 : 1 : 0 Neat.

336

364
336

28

C. qrs. lb.
Answer 33 : 1 : 00 Neat.

Troy

Troy-Weight.

Quest. 1. **I** ^{lb.} 57 : ^{oz.} 09 : ^{pwt.} 13 : ^{gr.} 15 how many Grains?

12 12 12 12

123 123 123 123

57 57 57 57

693 Ounces

20 20 20 20

13860 Pennywt

24 24 24 24

55440

27720

332640 Grains

332640 332640 332640 332640

332640 332640 332640 332640

332640 332640 332640 332640

332640 332640 332640 332640

332640 332640 332640 332640

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332640 332640 332640 332640

F

Quest. 2

Quest. 2. In 297456 Grains, how many Grains Goldsmiths Weight.

24) 297456 (12394 (619 (51 : 7 : 4 : 0

24 120 60 30

57
48

39
20

19
12

31
12

94
72

194
180

7

221
22

225
216

4 Pennywt.

96
96

0

Answer, 51 Pounds, 7 Ounces, 4 Penny-weight, 0 Grains.

Liquid-

Of Reduction.

69

Liquid-Measure.

Tuns hh. gall.

Quest. 1. **I**N 72 : 2 : 25 how many Quarts of Wine?

290 Hogheads.

63

875

1742

18295 Gallons.

4

73180 Quarts.

Tuns hhds. gall. Pott. Quart.

Quest. 2. **I**n 24 : 3 : 20 : 1 : 1 how many Pints?

4

99 Hogheads.

63

297

596

6257 Gallons.

2

12515 Pottles.

2

25031 Quarts.

2

50062 Pints.

Answer, 50062 Pints.

F 2

Thus

Thus 50062 Pint-Bottles, or 25031, Quart-Bottles of Wine may be filled out of the Quantity of Wine afore-recited.

Dry-Measure.

EXAMPLE.

Laft. Qu. Bush. Gall.
 Quest. 1. **I**N 46 : 5 : 3 : 2 how many Bushels of (Wheat.

10
 465 Quarters.

8
 3723 Bushels of Wheat.

Answer 2723 Bushels of Wheat.

Cloth-Measure.

Ells Eng. qrs. nail.
 Quest. 1. **I**n 546 : 3 : 2 how many Nails.

5
 2733 Quarters.

4
 10934 Nails.

Answer, 10934 Nails.

Quest. 2.

Of Reduction.

69

Yards qrs. nail.

Quest. 2. In 642 : 2 : 3 how many Nails.

4

2570 Quarters.

4

10283 Nails.

Answer, 10283 Nails.

Ells Flem. qrs. nail.

Quest. 3. In 9176 : 2 : 2 how many Yards.

3

27530 Quarters.

4

110122 Nails.

Yards qrs. nail.

4) 110122 (27530 (6882 : 2 : 2

8..... 24

30
28

35
32

21
20

33
32

12
12

10
8

02

2

F 3

Quest. 4.

Quest. 4. In 245 Yards, how many Ells *Englsh.*

$$\begin{array}{r}
 4 \\
 \hline
 980 \text{ Quarters.} \\
 \hline
 5 \overline{) 980} (196 \text{ Ells } \textit{Engl.} \\
 \underline{5 } \\
 48 \\
 \underline{45} \\
 30 \\
 \underline{30} \\
 0
 \end{array}$$

Quest. 5. In 196 Ells *Englsh.*, how many Yards.

$$\begin{array}{r}
 5 \\
 \hline
 980 \text{ Quarters.} \\
 \hline
 4 \overline{) 980} (245 \text{ Yards.} \\
 \underline{8 } \\
 18 \\
 \underline{16} \\
 20 \\
 \underline{20} \\
 0
 \end{array}$$

Quest. 6. In 245 Ells *Flemish*, how many Ells *Engl.*

$$\begin{array}{r}
 3 \\
 \hline
 735 \text{ Quarters.} \\
 \hline
 5 \overline{) 735} (147 \text{ Ells } \textit{Engl.} \\
 \underline{5 } \\
 23 \\
 \underline{20} \\
 35 \\
 \underline{35} \\
 0
 \end{array}$$

Long-

Long-Measure.

Quest. 1. **T**HE Circumference of the Earth being 360 Degrees, and every Degree 60 English Miles, how many Miles, Furlongs, Perches, Inches, and Barley-corns will reach round the World.

360 Degrees.
60 Miles to a Degree.

21600 Miles about the Earth,
8 Furlongs.

172800 Furlongs about the Earth,
40 Perches in a Mile.

6912000 Perches about the Earth,
33 Half Feet in a Perch.

20736000
20736000

228096000 Half Feet about the Earth,
6 Inches in a half Foot,

1368576000 Inches.
3 Barley-corns in an Inch.

4105728000 Barley-corns about the
Earth.

Again, *Quest. 2.* In 6482777 Feet, how many Miles,

	1760	
3)64827777	(21609259	(12277 Miles,
6	1760	
04	4009	
3	3520	
18	4892	
18	3520	
027	13725	
27	12320	
07	14059	
6	12320	
17	1739	Yards,
15		
27		
27		
0		Inch.

Three Feet 1 Yard, 1760 Yards makes a Mile.

Quest. 3.

Quest. 3. How many Barley-corns will reach from London to York, accounting it 150 Miles thither.

150

8

1200 Furlongs.

40

48000 Perches

33

144000

144000

1584000 half Feet.

6

9504000 Inches.

3

28512000 Barley-corns.

Answer, 28512000 Barley-corns.

Land.

Land-Measure.

Of superficial Measures of Land.

Quest. 1. **I**N 225 Acres, 13 Roods, and 30 Perches,
how many Perches.

225 Acres.

4

903 Roods.

40

36150 Perches for Answer.

Quest. 2. In 560 Acres, how many Perches.

560 Acres.

4

2240 Roods.

40

89600 Perches.

Answer, 89600 Perches.



Of TIME.

Quest. I would know how many Days, Hours, and Minutes it is since the Birth of our Saviour *Jesus Christ*, to this present Year 1720.

1720 Years.

365 Days in a Year.

8600

10320

5160

627800 Days since the Birth of Christ.

24 Hours in one Day.

2511200

1255600

1720

6

15067200

10320

10320 Hours to be added,

Hours added.

15077520 Hours since the Birth of Christ.

60 Minutes in an Hour.

904651200 Minutes in all.

Answer, 904651200 Minutes since our Saviour *Jesus Christ* was born.

Note, The Reason why the Hours are added, is, because that there are in every Year 365 Days and 6 Hours; therefore in 1720 Years, there have passed 10320 Hours.

Quest.

Quest. 2. A Lady born in the Year 1662, would know how many Years, Hours, and Minutes she hath lived.

1720

1662

58 Years she hath lived.

365 Days,

58 Years.

2920

1825

21170 Days she hath lived.

24

84680

58

42340

6

508080

348

Hours

348 Hours added. (added.)

508428 Hours the Lady hath liv'd

60

30503680 Minutes.

Answer, The Lady hath lived thirty millions five hundred, three thousand, six hundred and eighty Minutes.

Redu-

Reduction of Foreign Coins into our English Money, as also foreign Money into English, commonly called Reduction of Coins.

The RULE.

LET your second and third Numbers be both of one Denomination; then multiply your second under your first, and the Quotient is your Answer.

As for EXAMPLE.

Quest. 1. In 529l. Sterl. at 20 per l. how many Livres at 20 d. per Livre.

Livres	s.	d.
259	20	20
240	12	00
21160	240	00
1058	08	00
126960	00	00

20

Of Reduction.

20)126960(6348 Livres.

120

69

60

66

80

160

160

0

Answer 6348 Livres.

Quest. 2. In 6348 Livres at 20 *d.* how many Pounds Sterling, at 20 *s.* per l.

*s.**d.*

6348

20

20

20

12

126960

240

240)126960(529 Pounds Sterl.

1200

696

480

2160

2160

0

This Question is the reverse of the last.

Quest.

Of Reduction.

79

Quest. 3. In 7249 Flemish Pounds at 35 s. 6 d. how many Guineas at 21 s.

	s.	d.	s.
7249	35	6	21
426	12		12
43494	76		252
14498	35		
28996			
	426		
3088074			

Guineas.
252)3088074(12254-²⁵/₂

252	
568	
504	
640	
504	
1367	
1260	
1074	
1008	
66	

Answer, 12254-²⁵/₂ Guineas at London.

Quest. 4

Quest. 4 In 6340 *Flemish Ducatoons* at 5 s. 4 d. per Ducatoon, how many Pounds Sterling, at 20 s. per Pound.

Ducatoons	s.	d.	s.
6340	5	4	20
64	12		12
25360	64		240
38040			
405760			

240	405760	(1690— $\frac{168}{240}$ many Pounds Sterling)
240	1657	
	1440	
	2176	
	2160	
	160	

Answer, He must receive in London 1690— $\frac{168}{240}$ Pounds Sterling, for his *Flemish Ducatoons*.

Quest. 5.

Of Reduction.

81

Quest. 5. In 905 Guineas at 21 s. 6 d. per Guinea;
how many French Pistols at 17 s. 6 d.

Guineas	s.	d.	s.	d.
905	21	6	17	6
258	12		12	
7240	48		40	
4525	21		17	
1810				
	258		210	
233490				

Pistols.

$$\begin{array}{r}
 210 \overline{) 233490} \quad (1111 \frac{180}{210} \\
 \underline{210} \\
 234 \\
 \underline{210} \\
 249 \\
 \underline{210} \\
 390 \\
 \underline{210} \\
 180
 \end{array}$$

Answer, he must receive in France 1111 $\frac{180}{210}$ Pi
stols.

G

The

C H A P. VII.

The Rule of Three direct or the Golden Rule.

THIS Rule is so called, from its excellent Use in Numbers; whereby three Numbers known or given, to find a fourth unknown. It is called *The Rule of Proportion*, for the Reason hereafter declared.

2. Take care in the stating of your Question, That you always make your first and third Numbers of one Denomination, and the second Place being the Supposition, must after Operation be found in the same Degree with your fourth Number sought.

3. But for the better understanding of the Rule, by which this *Rule of Three direct* is worked, let this Direction be well observed and learn'd, if not learn'd by Heart, and the Learner will find the Benefit, viz.

The R U L E.

4. In this Rule you must make your first and third Numbers both of one Kind. Then go unto your second, or middle Number, and reduce that into the lowest Value there named; then multiply your second Number under your third, making that Number your Dividend, and divide by your first Number, and the Quotient of your *Division* answers the Question demanded, and is always of the same Denomination

The Rule of Three direct. 83

nomination with your second Number, whether Pounds, Shillings, Pence or Farthings, or any other Name or kind whatsoever; which if it shall happen to be of any great Number, whether of Weights, Measure, or Time, you may reduce them into its lowest Value, by the Rules of *Reduction* before taught.

As for EXAMPLE.

If 4 Days spend 12 s. what will 365 Days?

4)4380(109 5	12	
4	730	
—	365	
038	4380	
36		
—		
20		
20		
—		
0		
—		

l.	s.	d.
Answer, 54 : 15 : 00		

Thus, as you see the Rule directs, by multiplying your second Number under your third, the Product is 4380, which dividing by your first Number 4, the Quotient is 1095 Shillings, which is turned into Pounds by cutting off the last Figure, and halving the Number as you find above, which makes 54 l. 15 s. 00 d.

Another Question much after the same Reason, may serve for a second Example.

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EXAMPLE 2.

If 7 Days expend 2 l. 17 s. 9 d. 2 f. what will
148 Days.

$$\begin{array}{r}
 20 \\
 \hline
 57 \\
 12 \\
 \hline
 123 \\
 57 \\
 \hline
 693 \\
 4 \\
 2774 \\
 148 \\
 \hline
 20192 \\
 11096 \\
 2774 \\
 \hline
 4) \quad 12) \\
 7)408552 \quad (58364)14591(1215 \\
 35 \dots 4 \dots 12 \dots \\
 \hline
 58 \quad 18 \quad 25 \\
 56 \quad 16 \quad 24 \\
 \hline
 25 \quad 23 \quad 19 \\
 21 \quad 20 \quad 12 \\
 \hline
 45 \quad 36 \quad 71 \\
 42 \quad 36 \quad 60 \\
 \hline
 32 \quad 04 \quad 11 \\
 28 \quad 4 \quad \hline
 4 \quad 0
 \end{array}$$

Answer, 60 l. 15 s. 11 d. 0 far. $\frac{4}{7}$.

The

The Rule of Three direct. 85

The Explication of the last Example, you may observe, is performed (as by the Rule it appeareth) by bringing your second Number into the lowest Value there named, which is Farthings, and so multiplying your third Number under your second, your Product is 408552; which being divided by your first Number 7, the Quotient is 58364; which by Reason your middle Number is Farthings, the Quotient is 58364 Farthings; which being reduced into Pounds, Shillings, Pence and Farthings, maketh the Product, as before, 60 Pounds, 15 Shillings, 11 Pence, 0 Farthings, and $\frac{2}{3}$ of a Farthing.

A third E X A M P L E.

If 1 C. Weight of Tobacco cost 4 *l.* 5 *s.* 2 *d.*, what will 34 C. 3 *qrs.* 18 *lb.* cost at that Rate.

In this Example, because the third Number mentions Pounds, therefore the first and third Numbers must be brought into Pounds, and the second Number into Pence, and then the second Number being multiplied by the third, the Product is Pence; which being reduced maketh 148 *l.* 13 *s.* 02 *d.* and 84 Remaineth, and what the Remainder maketh, shall be taught as we learn farther. See the Work.

G 3

EX-

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The Explanation of the last Example, you may observe, is given in a particular manner, by bringing your second Number into the lower

EXAMPLE 3.

lb. l. s. d. C. qrs. lb.

112 — 4 : 5 : 2 — 34 : 3 : 18

20 4

85 139

12 28

172 1120

85 279

1022 3910

1022

7820

7820

9100

3996020

12

112)3996020(35678(297|3

336 24

636 116

560 108

760 87

672 84

882 38

784 36

980 2

896

84

Answer, 148 l. 13 s. 2 d. 11 1/2 q.

EX

The Rule of Three direct 87

EXAMPLE 4.

If 1 Year have 3756 l. 14 s. 9 d. what is 1 Day.

Days l. s. d. Day

365 — 3756 : 14 : 9 — 1

20

75134

12

150277

75134

12)

365)901617(2470(2015

730... 24... d.

10 5 : 10 $\frac{867}{365}$.

1716

070

1460

60

2561

10

2555

67

l. s. d.

Answer, 10 : 5 : 10 — $\frac{867}{365}$.

G 4

EX

88 The Rule of Three direct.

Example the 5th, or the Proof of the last Question.

Day l. s. d. Days
If I spend 10 : 5 : 10 — $\frac{827}{365}$ what will 365

20

205

• 12

420

206

2470

365

12357

14826

7410

12)901617(751314

84.....

3756 l. 14 s. 9 d. for Answer,

61

60

16

12

41

36

57

48

9

In multiplying 365 under 2470, there is taken in the Remainder 67, as by the Operation.

EX-

The Rule of Three direct. 89

EXAMPLE 6.

What comes 14 : 2 : 13 of Sugar to at 4 $\frac{1}{2}$ p. Pound.

$\frac{1}{2}$ Sugar d. C. qrs. $\frac{1}{2}$ d.
 1 ————— 4 $\frac{1}{2}$ ————— 14 : 2 : 13

4

4

18

58

28

467

117

1637

18

13096

1637

29466

4)29466)7366(61|3

28 72

30 | 13 : 10 : $\frac{1}{2}$.

14

16

12

12

26

46

24

36

26

10

24

2

Answer, 30 l. 13 s. 10 d. $\frac{1}{2}$.

Observe, When the first Number is 1 or Unity, then the Product of your third Number is of the same Denomination as you left your second Number in; as in this Example 'tis Farthings, therefore 29466 is Farthings.

E X-

EXAMPLE 7.

If 1 Ounce of Silver cost 5 s. 3 d. what will 46 Ounces, 13 Pennyweight and 12 Grains Cost.

oz.	s.	d.	oz.	pwt.	grains.
1	5	4	46	13	12
20	12		20		
20	64		933		
24			24		
80			3734		
40			1867		
480			22404		
			64		
			89616		
			134424		
			1433856		
12					
480) 1433856	(2987	(24			
960	24				
	12	8	11		$\frac{226}{480}$
4738	58				
4320	48				
4185	107				
3840	96				
3456	11				
3360					
96					
Answer, 12 l, 8 s, 11 $\frac{226}{480}$.					
E X-					

The Rule of Three direct. 91

EXAMPLE 8.

If a Piece of Scarlet costs 189 l. 19 s. and a Yard is sold for 3 l. 15 s. 8 d. how many Yards were in the Piece. Stated thus:

l.	s.	d.	l.	s.
3	15	8	189	19
20			20	
75			3799	
12			12	
158			7598	
75			3799	
908			45588	

Yards.

908)45588(50— $\frac{1}{2}\frac{1}{2}\frac{1}{2}$.

4540

188

Answer, 50 Yards— $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ Parts.

EX-

92 The Rule of Three direct.

EXAMPLE 9.

What will the Interest of 876 *l.* 17 *s.* 6 *d.* amount unto for 1 Year, at the Rate of 6 *l.* for every 100 *l.* for the same Time. Thus,

<i>l.</i>	<i>l.</i>	<i>l.</i> <i>s.</i> <i>d.</i>
If 100 principal gain 6 Interest,	what will 876-16-6	
20	20	20
2000	120	17536
12	12	12
24000	1440	35078
		17536
		210438
		1440

24 000)303030 720(12626(105 2	8417520
24	841752
63	52 12:2 210438
48	303030720
150	26
144	24
63	2
48	
150	
144	
6	

Answer, 52 *l.* 12 *s.* 2 *d.* $\frac{6}{24}$ $\frac{1}{4}$.

EX-

The Rule of Three direct. 93

EXAMPLE. 10.

At 15 d. $\frac{1}{2}$ p. lb. how many hundred Weight for 11 l. 11 s. 11 d.

d. lb. l. s. d.
If 15 $\frac{1}{2}$ Buy 1 ——— how many for 11 : 11 : 11

4

62

20

231

12

463

232

2783

4

11132

28 4 C. grs. lb.

62)11132(1796(1 : 2 : 11 — $\frac{14}{62}$ $\frac{17}{31}$.

62... 168 4

493

11 2

434

[— —]

592

558

34

Answer 1 C. 2 grs. 11 lb. $\frac{17}{31}$.

Let the Learner observe once for all in the Prosecution of his Examples, the right stating of his Question ; for if Weight, Measure or Interest-Money be demanded, or whatever it is, you must always place your Demand in the second Place, and your Quotient answers to that Denomination. See your Rule. Thus

94 *The Rule of Three direct.*

Thus having demonstrated the Reason of this Rule in the ten foregoing Examples, I shall proceed now to propose several Questions in this for the Learner's Practice, and only set down their *Facits*, as a further Help.

Quest. 1. What is the Price of a Pint of Oil, when a Tun costs 35 *l.* 12 *s.* 9 *d.*

4 hogheads a Tun

Answer, 4 *d.* $\frac{163}{672}$.

Quest. 2. What is the Value of a Pound of Indico, when a Tun costs 1000 *l.*

20 C. 1 Tun.

Answer, 8 *s.* 11 *d.* $\frac{3}{7}$.

Quest. 3. Bought three Hogheads of Nutmegs at 5 *s.* 7 *d.* the Ounce, weighing in all 12 C. 2 *qrs.* 25 *lb.*

Answer, 6365 *l.*

Quest. What may be spent a Day out of an Estate of 3050 *per Annum*, there being a Reservation of, *viz.*

l.

300 for Taxes.

l.

005 for pious Uses, and

3050

200 for Annuities.

505

505

2545 clear Esta.

305

2545

1

Answer, 6 *l.* 19 *s.* 5 *d.*

Quest. 5.

The Rule of Three direct. 95

Quest. 5. A Gentleman expendeth daily one Day with another 27 s. 10 d. $\frac{1}{2}$. and at the Year's End layeth up 340 l. what is his yearly Income thus:

Day	s.	d.	Days	l.	s.	d.
1	27	10 : $\frac{1}{2}$	365	Ans.	508	14 : 4 $\frac{1}{2}$
				add	340	00 : 0

Answer, 848 l. 14 s. 4 d. $\frac{1}{2}$. 848 : 14 : 4 $\frac{1}{2}$

Quest. 6. If 100 lb. of Cloves cost 89 l. 11 s. 10 d. and 112 lb. of Mace for 96 l. 10 s. 2 d., what cost 3 Ounces one with another.

l.	s.	d.
100	89	11 : 10
112	96	10 : 02
add		
212	186	02 : 00

lb.	l.	s.	d.	oz.
212	186	02	00	3

Answer, 3 s. 3 d. $\frac{17}{33} \frac{4}{2}$.

Quest. 7. If a Pennyweight of Gold be worth 3 s. 6 d. $\frac{1}{2}$ what is a Pound of that Gold worth?

Answer, 42 l. 10 s. 0 d. $\frac{1}{2}$.

Quest. 8. What Part of Time does answer to 15 Degrees of the Equinoctial.

deg.	hours	deg.
360	24	15

Answer, 1 Hour.

So that every Hour Answers 15 Degrees in the Sun's Diurnal Motion.

Quest. 9.

Quest. 9. A Gentleman hath owing him 357 *l.* 9 *s.* and his Debtor doth agree with him to pay 13 *s.* 5 *d.* for every 20 *s.* what ready Money must he pay him.

Answer, 239 *l.* 15 *s.* 9 *d.* $\frac{1}{4}$.

Quest. 10. A Goldsmith buys an Ounce of old wrought Silver for 5 *s.* per Ounce, what is the Price of 14 Ingots of Silver, each Ingot weighing 7 $\frac{1}{2}$ *lb.* 5 *oz.* 10 *pwt.*

Answer, 313 *l.* 05 *s.* 0 *d.*

Quest. 11. If a Wedge of Gold weighing 17 *l.* of Troy-weight be worth 679 *l.* 12 *s.* 06 *d.* what is a Grain of that Gold worth?

Answer, 1 *d.* $\frac{1}{2}$ $\frac{1623}{2648}$.

Quest. 12. What Principal in 12 Months Time will gain 64 *l.* 10 *s.* at the Rate of 6 *l.* per Cent.

<i>Int.</i>	<i>Principal</i>	<i>l.</i>	<i>s.</i>	<i>Int.</i>
6	100	64	10	

Answer, 1075 *l.*

Quest. 13. If Coffee be sold for 7 *s.* 6 *d.* a Pound, what is 1 Ounce worth?

Answer, 5 *d.* $\frac{1}{2}$ $\frac{9}{16}$ half Farth.

Quest. 14. A Butcher bought an Ox (weighing besides Skin and Legs) 898 Pounds, the Ox cost him 12 *l.* he sold the Skin and Legs for 22 *s.* 4 *d.* and 16 $\frac{1}{2}$ *lb.* $\frac{1}{4}$ Stone of Tallow at 5 *d.* $\frac{1}{2}$ per Pound, what doth a Stone of Beef stand him in at 8 $\frac{1}{2}$ *lb.* a Stone, and how must he sell a Stone to gain 40 *s.* in the whole Ox.

Stone

The Rule of Three direct. 97

Thus,

Stone d. l. s. d.
 16 $\frac{1}{4}$ at 5 $\frac{1}{2}$ comes to 2 : 19 : 7 the Tallow.
 1 : 02 : 4 Skin and Legs.

 4 : 01 : 11

12 : 00 : 00
 4 : 01 : 11 subtract.

 7 : 18 : 01 Rest.

lb	l.	s.	d.
898	7	18	01

lb	8
----	---

Answer 16 d. $\frac{3}{4}$ prime Cost.

Then for him to gain 2 l. add it to the prime Cost, and then it becomes 9 l. 18 s. 01 d.

lb	l.	s.	d.
898	9	18	01

8

Answer, 21 l. he sells it for to gain 40 s.

H

Quest;

98 The Rule of Three direct.

Quest. 15. Sold 45 C. 3 qrs. 15 l. of Raisins, Tare 16 lb. per. every hundred Weight, Tret 4 l. per 104, at 3 d. $\frac{1}{4}$ per lb Neat what do the Raisins amount unto.

C.	qrs.	lb.	C.	qrs.	lb.
45	: 3	: 15	45	: 3	: 15
4			16		Tare.

183 Quarters.
28

270

1469
367

720

14 allowed for 3 qrs. 15 lb

5139 lb Gross.
734 Tare.

734 lb Tare.

4405 lb Subtle.
169 lb Tare.

26)4405 (169 Tret.

4236 lb Neat.

180

156

245

234

11

Then place it in your Rule.

If 1 $\frac{l.}{d.}$ 3 $\frac{1}{4}$ 4236

Answer, 66 l. 3 s. 9 d.

Quest. 16.

The Rule of Three direct. 99

Quest. 16. In 76 Hogsheads of Tobacco weighing each 3 C. 2 qrs. 17 lb. Tare, 12 l. per Hundred and 6 l. per Hogsheads, Tret 4 l. per 104 at 2 d. $\frac{1}{2}$ per lb Neat, how much Money doth it amount unto.
Thus:

C. qrs. lb.		C. qrs. lb.
3 : 2 : 17	112) 31084	(277 : 2 : 4
4	224	12
<u>14</u>	868	554
28	784	277
<u>119</u>	844	3324
29	784	6
<u>409 lb in 1 Hoghead.</u>	60	3330 lb Tare p.C.
76		
<u>2454</u>	76	
2863	6	
<u>31084 lb in all.</u>	456	Tare per Hogsheads
3330 Tare per Hundred.		
<u>27754 Remainder.</u>	26) 27298	(1049 lb Tret.
456 Tare per Hogsh.	26	
<u>27298 lb Subtle.</u>	129	
1049 Tret.	104	
<u>26249 lb Neat.</u>	258	
	234	
	24	

Then place in your Rule.

1 l. — 2 d $\frac{1}{2}$. what 26249 l. — of Tobacco.
Your Answer will be 273 l. 8 s. 6 d. $\frac{1}{2}$.

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Quest. 17. If *Exeter* be distant from *London* 140 Miles, and that at the same Time one Footman, viz. *A*, departed from *London* towards *Exeter*, travelling every Day 8 Miles. The other Footman *B* comes from *Exeter* towards *London*, and he travelleth every Day 6 Miles; the Question is to know how many Days it will be before they meet one another, as also to know how many Miles each Footman will have then travelled.

Answer, They will meet at the End of 10 Days, and then *A* will have travelled 80 Miles and *B* 60.

Thus found.

add { 8 Miles travelled by *A* daily.
 { 6 Miles travelled by *B* daily.

14

14 Miles which *A* and *B* together did travel.

	<i>Then,</i>	
	Miles Days	Miles Days
14) 140 (10	If 14 ——— 1 ———	140 (10

In which Time *A* and *B* meet.

Therefore 10 multiplied by 8 makes 80 *A*:

10 multiplied by 6 makes 60 *B*. accord-
to the Question:

The Proof of the Rule of Three direct.

For the Proof of *The Rule of Three direct*, you must multiply the fourth Term (or Answer to the Question) by the first, and if the Product thereof be

The Rule of Three direct. 101

be equal to the Product of the second and third, then is the Operation truly performed. But if it happen that after the fourth Term, you shall find in the Division a Remainder, such Remainder must be added to the Product of the first Term. So in the fourth Example in this Rule.

Days	Pence	Day	Pence
365	901617	1	Answer 2470 $\frac{267}{3}$.

So in this Example, the fourth Term is 2470, and there happens to be a Remainder of 67, which being added to the Multiplication of the said 2470, makes it equal to the Product of the second and third.

Thus:

2470 First and Fourth with the Remainder 67,
365 is equal to the first and Fourth.

12350
14820
7410
—

901550

67 added.

901617 second Term.
1 third Term.

901617 Product.

901617 Product.

This is the common Proof, and readily performed, but for the Learners better Proficiency, I would advise him to prove his Question backward, as you may see in the Example of the 4th and 5th of this Rule.

Note, When the first of the three given Terms in the Rule of Three direct is 1 or Unity, the Question will soon be answered by the Rule of Practice, which said Rule I therefore place next to be learned.

And I

H 3

Rules

CHAP. VIII.

Rules of PRACTICE.

IT is commonly called the Rule of PRACTICE, from the great Use and Practice thereof in common Affairs.

2. All Questions that are resolved by this Rule, must have 1 or Unity for the Demand : As for Example ; If 1 Ounce cost 2 s. 3 d. $\frac{1}{4}$. what will 28 Ounces.

3. In the farther Prosecution of this Rule, I shall begin with 1 Penny, and so proceed gradually by breaking all the aliquot Parts unto a Shilling ; the Manner how will be seen in the Margent.

4. You must be perfect in your Table of Twelves, and to divide a single Figure by Memory.

T A B L E of Twelves.

1	12	12
2	12	24
3	12	36
4	12	48
5	12	60
6	12	72
7	12	84
8	12	96
9	12	108
10	12	120
11	12	132
12	12	144

I shall

The Rule of Practice.

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I shall for the better understanding and help to the Learner, to initiate him in this *Rule of Practice*, begin with the even Parts of a Shilling.

Quest. 1. What comes
948 Yards to at 1 d. per
Yard.

Answer, 3 l. 19 s.

Yards d.
12) 948 at 1 per Yard.

7 | 9—00

3 | 19—00

When the Price is an even Part of a Shilling, consider what Part it is; which being found, divide the Sum propounded by it, and the Answer will be in Shillings, which by cutting off the last Figure, you convert into Pounds.

oz. d.
Q. 2. 2. 3) 3618 at 1 ½ p. oz.

45 | 2—3—00

Answer, 22 | 12—3

Ells d.
6) 4956 at 2 per Ell.

82 | 6—00

Ans. 41 | 6—00

l. d.
4) 276 at 3 per lb.

6 | 9—00

Ans. 3 | 9—00

Ells d.
3) 867 at 4 per Ell.

28 | 9—00

Ans. 14 | 9—00

Yards d.
2) 9756 at 6 per Yard.

487 | 8—00

Ans. 243 | 18—00

H 4

Having

104 The Rule of Practice.

Having gone thus far, I shall now proceed gradually from one Penny to a Shilling.

Yard d.
12) 549 at 1 per Yard.

4|5 : 9

2|5 : 9

Days d.
12) 7869 at 1 $\frac{1}{4}$ per Day.

4) 655 : 9
163 : 11 : $\frac{1}{4}$

81| 9 : 8 : $\frac{1}{4}$

40|19 : 8 : $\frac{1}{4}$.

The Explanation of this Question.

You may by this Question, observe that as 1 d. is the $\frac{1}{2}$ of a Shilling, and so 1 Farthing is the $\frac{1}{4}$ of that Penny, so by Consequence dividing 655 Shillings and 9 Pence by 4, there is found 163 Shillings 11 Pence 1 Farthing; which being added, there will be found 819 Shillings, 8 Pence 1 Farthing,

which being converted into Shillings, makes

40l. 19s. 8d. 1f.

Days d.
8) 748 at 1 $\frac{1}{2}$ per Day.

9| 3 : 6

4|13 : 6

Ell. d.
8) 5260 at 1 $\frac{1}{4}$ per Ell.

6) 657 : 6
109 : 7

76|7 : 1

38|7 : 1

Note, This Question is thus performed, first, I say 1 d. $\frac{1}{2}$ is the $\frac{1}{2}$ of a Shilling, and then 1 Farthing is the $\frac{1}{4}$ of that Line, as per the Operation.

Yards d.
6) 9510 at 2 per Yard.

158|5 : 00

79|5 : 00

The Rule of Practice. 105

6) 3482 at 2 $\frac{1}{4}$ d. to bid

8) 580 : 4 d. the 1

72 : 6 : $\frac{1}{2}$ d. and the 1

65 : 10 : $\frac{1}{2}$ d. the 1

32 : 12 : 10 : $\frac{1}{2}$ d. the 1

l. d. 00 : 115 (8)

6) 9790 at 2 $\frac{1}{2}$ per lb.

4) 1631 : 8

407 : 11

203 : 9 : 7

101 : 19 : 7

Days d. 00 : 115 (8)

6) 7950 at 2 $\frac{1}{4}$ per Day.

4) 1325 : 00

2) 331 : 03

165 : 07 $\frac{1}{2}$

182 : 1 : 10 : $\frac{1}{2}$

91 : 1 : 10 : $\frac{1}{2}$

Note, By Reason 3 Farthings is no equal Part of

2 Pence, it is therefore broke into a Halfpenny, and a Farthing, and the Work so divided.

oz. d. 00 : 115 (8)

4) 768 at 3 per oz.

19 : 2 : 00

9 : 12 : 00

Dram d. 00 : 115 (8)

4) 4270 at 3 $\frac{1}{4}$ p. Dram.

12) 1067 : 6

88 : 11 : $\frac{1}{2}$

115 : 6 : 05 : $\frac{1}{2}$

57 : 16 : 05 : $\frac{1}{2}$

Yards d. 00 : 115 (8)

4) 594 at 3 $\frac{1}{2}$ per Yard.

6) 148 : 6 : 0

24 : 9 : 0

17 : 3 : 3 : 0

8 : 13 : 3 : 0

lb d.
4) 5968 at $3\frac{1}{4}$ p. *lb.*

4) 1492 : 00
373 : 00

18615 : 00

9315 : 00

oz d.
3) 482 at 4 per Ounce.

1610 : 8

810 : 8

Ells d.
4) 7984 at $4\frac{1}{4}$ p. Ell.

3) 1996 : 00

4) 665 : 04

166 : 04

28217 : 08

14117 : 08

This Question of 7984 Ells at $4\frac{1}{4}$ d. must be broke thus; for by Reason that 1 Farthing is no even Part of 4 d. (within the Compass of the Ta-

ble of Twelves, therefore you must say, that 3 d. is the $\frac{1}{4}$ of a Shilling 1 d. the $\frac{1}{2}$ of three Pence, and 1 Farthing the $\frac{1}{4}$ of that Penny; as by the foregoing Operation.

Days d.

3) 642 at $4\frac{1}{2}$ per Day,

8) 214 : 00

26 : 09

2410 : 09

1210 : 09

Yards d.

3) 7684 at $4\frac{1}{4}$ p. Yard.

8) 2561 : 4

2) 320 : 2

160 : 1

20411 : 7

15211 : 7

Again, *Ells d.*

3) 5971 at 5 per Ell.

4) 1991 : 4

447 : 10

24319 : 02

12119 : 02

3)

The Rule of Practice.

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3) 6480 at 5 $\frac{1}{4}$ per Ell.

4) 2160 : 0

4) 540 : 0

135 : 0

283 | 5 : 0

141 | 15 : 0

8) 3) 916 at 5 $\frac{1}{2}$

305 : 4

114 : 6

41 | 9 : 10

20 | 19 : 10

Note, In this Question you may see that 916 is divided both by 3 and 8, because that 4 d. is the $\frac{1}{2}$ of a Shilling, and 1 d. $\frac{1}{2}$, is the $\frac{1}{4}$ of a Shilling.

Yards d.
8) 3) 7613 at 5 $\frac{1}{4}$ per Yd.

6) 2537 : 8

958 : 7 $\frac{1}{2}$

158 : 7 $\frac{1}{4}$

364 | 7 : 10 $\frac{1}{4}$

182 | 7 : 10 $\frac{1}{2}$

Days d.
2) 9174 at 6 per Day.

458 | 7 : 00

229 | 17 : 00

Ells d.
3) 796 at 6 $\frac{1}{4}$ per Ell.

2) 265 : 4

8) 132 : 8

16 : 7

41 | 4 : 7

20 | 14 : 7

Note, Here 6 d. is divided into two Parts, viz. 4 d. and 2 d. to bring in the odd Farthings

Yards d.
2) 5410 at 6 $\frac{1}{2}$ per Yard.

12) 2705 : 00

225 : 05

293 | 0 : 5

146 | 10 : 5

Yards

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$$\begin{array}{r} \text{Yards } d. \\ 2) 719 \text{ at } 6 \frac{1}{4} \end{array}$$

$$\begin{array}{r} 4) 359 : 6 \\ 89 : 10 \frac{1}{2} \end{array}$$

$$449 : 4 \frac{1}{2}$$

$$229 : 4 \frac{1}{2}$$

$$2) 5270 \text{ at } 7 \frac{1}{2}$$

$$\begin{array}{r} 6) 2635 : 0 \\ 439 : 2 \end{array}$$

$$307 \frac{1}{4} : 2$$

$$153 \frac{1}{4} : 2$$

$$2) 6510 \text{ at } 7 \frac{1}{4}$$

$$6) 3255 : 0$$

$$4) 542 : 6$$

$$135 : 7 \frac{1}{2}$$

$$393 \frac{1}{3} : 1 \frac{1}{2}$$

$$196 \frac{1}{3} : 1 \frac{1}{2}$$

$$8) 2) 3954 \text{ at } 7 \frac{1}{2} d.$$

$$\begin{array}{r} 1977 : 0 \\ 494 : 3 \end{array}$$

$$247 \frac{1}{2} : 3$$

$$123 \frac{1}{2} : 3$$

$$4) 3) 9104 \text{ at } 7 \frac{1}{4} p. \text{ Yard } d.$$

$$3034 : 8$$

$$4) 2276 : 0$$

$$569 : 0$$

$$587 \frac{1}{2} : 8$$

$$293 \frac{1}{2} : 8$$

Note, The aliquot Parts are broke thus: 4 *d.* is the $\frac{1}{2}$ of a Shilling, 3 *d.* the $\frac{3}{4}$ of a Shilling, and 3 Farthings the $\frac{3}{4}$ of 3 Pence.

$$\begin{array}{r} oz. d. \\ \frac{2}{3}) 2744 \text{ At } 8 p. oz. \end{array}$$

$$914 : 8$$

$$914 : 8$$

$$1829 : 4$$

Or

The Rule of Practice. 1091

Or thus,

2) 2744 at 8 *d.* per oz.

3) 1372 : 00

457 : 04

182|9 : 04

91|9 : 04

Note. Both these Questions answer one another, although the aliquot Parts are broke diversly; for 8 *d.* is the $\frac{2}{3}$ of a Shilling in the first, and in the second Sum it is broke by 6 *d.* and 2 *d.*

2) 7370 at 8 $\frac{1}{4}$ *d.*

3) 3685 : 00

8) 1228 : 04

153 : 06 $\frac{1}{2}$

506|6 : 16 $\frac{1}{2}$

253|6 : 10 $\frac{1}{2}$

2) 9190 at 8 $\frac{1}{2}$ *d.*

3) 4595 : 00

4) 1531 : 08

382 : 11

650|9 : 07 : 04

325|9 : 07

2) 5182 at 8 $\frac{1}{4}$ *d.*

3) 2591 : 00

4) 863 : 08

2) 215 : 11

107 : 11 $\frac{1}{2}$

377|8 : 06 $\frac{1}{2}$

188|18 : 06 $\frac{1}{2}$

2) 9999 at 9 *d.*

3) 4999 : 6

2499 : 9

749|9 : 03

374|19 : 03

2)

1101 The Rule of Practice.

<i>d.</i>		<i>Days d.</i>	
2)	6166 at 9 $\frac{1}{4}$	3)	5910 at 10 per Day.
2)	3088 : 00		1970 : 00
12)	1544 : 00	2)	1970 : 00
	128 : 08		985 : 00
	476 0 : 08		492 5 : 00
	238 0 : 08		246 5 : 00
<i>d.</i>		<i>Days d.</i>	
2)	7184 at 9 $\frac{1}{2}$.	3) 2)	5910 at 10 p. Diem
2)	3592 : 00		2955 : 00
6)	1791 : 00		1970 : 00
	298 : 06		
			492 5 : 00
	568 1 : 06		
			246 5 : 00
	284 1 : 06		
<i>d.</i>		<i>d.</i>	
2)	3111 at 9 $\frac{1}{4}$.	3)	7177 at 10 $\frac{1}{4}$.
2)	1555 : 06		2392 : 4
4)	777 : 03	2)	2392 : 4
	194 : 03 $\frac{1}{4}$	8)	1196 : 2
			149 : 6 $\frac{1}{4}$
	252 7 : 00 $\frac{1}{4}$		6130 : 4 $\frac{1}{4}$
	126 7 : 00 $\frac{1}{4}$		30610 : 4 $\frac{1}{4}$

Days

The Rule of Practice. III

Days d.
 $\frac{2}{3}$) 397 at $10 \frac{1}{2}$

132 : 4

2) 132 : 4

4) 66 : 2

16 : $6 \frac{1}{2}$

34|7 : $4 \frac{1}{2}$

17|7 : $4 \frac{1}{2}$

d.
 3) 2) 528 at $10 \frac{1}{4}$

8) 264 : 00

176 : 00

33 : 00

47|3 : 00

23|13 : 00

Days d.
 4) $\frac{2}{3}$) 5612 at 11 p. Day.

1870 : 8

1870 : 8

1403 : 0

514|4 : 4

257|4 : 4

Note, Observe that in this Question, 8 d. is here taken out of the Shillings Line being $\frac{2}{3}$, and the 3 d. being the $\frac{1}{4}$ out of the same Line for that 8 d. and 3 d. is eleven Pence.

Ells. d.
 $\frac{1}{4}$) $\frac{2}{3}$) 3120 at $11 \frac{1}{4}$ per Ell.

1040 : 00

1040 : 00

12) 780 : 00 taken out of the first Line.

65 : 00

192|5 : 00

96|5 : 00

4)

d.
4) $\frac{2}{3}$) 565 at 11 $\frac{1}{2}$

188 : 4 : 0

188 : 4 : 0

6) 141 : 3 : 0 the first Line di-

23 : 6 : $\frac{1}{2}$ vided by 4

54|1 : 5 : $\frac{1}{2}$

27|1 : 5 : $\frac{1}{2}$

d.
 $\frac{1}{4}$) $\frac{2}{3}$) 3102 at 11 $\frac{1}{4}$

1034 : 0 : 0

1034 : 0 : 0

4) 775 : 6 : 0

193 : 10 : $\frac{1}{2}$

303|7 : 4 : $\frac{1}{2}$

151|17 : 4 : $\frac{1}{2}$

Days

s.

5384 at 1 the Day.

538|4

Only set down the Sum,
and cut off the last Fi-
gure and halve it.

269|4

If the Questions after propounded be more than one Shilling, it is but multiplying the Sum by so many Shillings, and cut off the last Figure to convert it into Pounds, as hath been performed throughout.

A few Examples will demonstrate the Reason.

As

The Rule of Practice. 113

As for **EXAMPLE.**

Ells s.
596 at 2 p. Ell.

$$\begin{array}{r} 2 \\ \hline 2 \text{ } 0 \text{) } 119 \text{ } 2 \\ \hline 59 \text{ } 12 \\ \hline \end{array}$$

Yards s.
7694 at 8 per Yard.

$$\begin{array}{r} 2 \text{ } 0 \text{) } 6155 \text{ } 2 \\ \hline 3077 \text{ } 12 \\ \hline \end{array}$$

Day s.
3148 at 12 per Day.

$$\begin{array}{r} 6296 \\ 3148 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \text{ } 0 \text{) } 3777 \text{ } 6 \\ \hline 1888 \text{ } 16 \\ \hline \end{array}$$

Days

The Rule of Practice.

Days s.

365 at 16 per Day.

16

2190

16 s. a Day is 292 l. a

365

Year.

5840

2920

If the Question be propounded in Pounds, it is but turning the Pounds into Shillings, and multiply them as before taught.

As for EXAMPLE.

l. s. d.

728 at 1 : 17 : 00

37

5096

2184

26936

134616

So that 728 Pounds of Indico cost one Pound seven-teen Shillings, the Answer will be found 1346 Pounds sixteen Shillings.

Note, If the Question be propounded in Pounds, Shillings, Pence and Farthings, 'tis but converting the Pounds into Shillings, and taking in the Shillings to the Pounds, and for the odd Pence and Farthings, they must be broken into the Parts of a Shilling, and taken out of the given Sum.

So

The Rule of Practice. 115

So that the whole Rule of *Practice* is by this Way fully learn'd and taught, by Reason: nothing can be proposed from a Penny to a Shilling, but what is broke into the even Parts: A few Examples will make it fully appear.

Thus,

$$\begin{array}{r} \text{Yards} \quad \text{lb.} \quad \text{d.} \\ 2) \quad 724 \text{ at } 2 \quad 12 : 6 \frac{1}{2} \\ \hline 362 \end{array}$$

$$\begin{array}{r} 1448 : 2201 \\ 3620 : 804 \end{array}$$

$$\begin{array}{r} 37648000 \\ 12) 362 : 0 \\ \hline 30166666 \end{array}$$

$$38040 : 2$$

Answer, 1902 lb. 0 s. 1 d. 0 f.

$$\begin{array}{r} 8 : 08 \\ 1 : 01 \end{array} \quad (2)$$

$$0 : 0200$$

Answer, 0 : 0200

1 2

Some

So that the whole Rule of Practice is by this Way
Some more Examples, it is presumed, will make you
perfectly proposed from a Pennyworth, but what is
 broke into the even Parts: A few Examples will
 make it full.

8) 2) 3271 at 3 : 15 : 7 $\frac{1}{2}$.

75

16355
 1 : 22897

245325

1635 : 6

408 : 10 $\frac{1}{2}$

247369 : 04 $\frac{1}{2}$

123689 : 04 $\frac{1}{2}$ Answer.

Cwt. l. s. d.
 3) 242 at 5 : 15 : 4 $\frac{1}{2}$ per Hundred-weight.

115

1210

242

242

27830

8) 80 : 8

10 : 1

27920 : 9

13960 : 9 Answer.

5 l. 15 s. is 115
 Shillings.

For

The Rule of Practice. 117

For the better understanding of this last Question, I will prove it by the Rule of Three direct.

C. L. s. d. C.
If 1 cost 5 : 15 : 4 : 2 what will 242

W

HERE the Quantity, whose Price is sought, consists of entire Hundred Weights, and of some number of Pounds, which is not an aliquot Part of 100, or of an Hundred weight.

20
115
234
115
1384
4
5538
242

1940
6811

11076
22152
11076
41340196(335049(279210
1396 : 00 : 09 : 00
95
84
110
108
108

The Example mentioned being of those Questions, which ordinarily happen in Trade) one of the hardest is resolved by the Rule of Practice, I shall therefore illustrate and explain the foregoing Operation, where you may observe the Price of

(Answer, The same with the Rule of Practice ; viz. 1396 l. 00 s. 09 d. 00 f. take 14 l. Part of

134 Practice

118 The Rule of Practice.

For the better understanding of this last Question

Practice of Avoirdupois-Weight.

WHERE the Quantity, whose Price is sought, consists of entire Hundred Weights, Quarters of an Hundred-weight, and of some Number of Pounds, which is not an aliquot Part of 28 lb, or $\frac{1}{4}$ of an Hundred-weight.

As in this **EXAMPLE**

C. qrs. lb. l. s. d.
3) 973 : 3 : 21 at 3 : 12 : 4 per C.
72

1946
6811

70056 : 0
324 : 4
Qrs.— 18 : 1
18 : 1
2) 18 : 1
2) 9 : 0 : $\frac{1}{2}$
4 : 6 : $\frac{1}{4}$

70448 : 1 : $\frac{1}{4}$

35228 : 1 : $\frac{1}{4}$

For 3 qrs. take the $\frac{1}{4}$ of Price, and let it 3 times down, because it is 3 qrs.

14 $\frac{1}{2}$ of 1
7 $\frac{1}{2}$ of 14 lb.

Answer.

(Answer, The same with the Rule of Practice)

the 24 lb. I take 1/2 of the Price of 1 lb. of 28. Like
 wife for 7 lb. I take 1/2 of the Price of 1 lb. of 28. Like
 there you may see the which I do by the Rule of Practice
 by laying 28 lb. is the 1 lb. and the 1 lb. of 28. Like
 2 lb. I take 1/2 of the Price of 1 lb. of 28. Like
 found to be very near 1266 Pounds

$ \begin{array}{r} 1090 \\ 218 \\ \hline 218 \\ \hline 25070 : 00 : 0 \\ 6) - 109 : 00 : 0 \\ 4) - 18 : 02 : 0 \\ \quad 4 : 06 : \frac{1}{2} \\ 3 \text{ Qrs } 28 : 10 : 3 \frac{1}{4} \\ \quad 28 : 10 : 3 \frac{1}{4} \\ 2) \quad 28 : 10 : 3 \frac{1}{4} \\ 7) 2) \quad 14 : 05 : 1 \frac{3}{4} \\ \quad \quad 7 : 02 : 2 \frac{3}{4} \\ \quad \quad 2 : 00 : 3 \\ \quad \quad 2 : 00 : 1 \\ \hline 2532 2 : 03 : 2 \\ \hline 1266 2 : 03 : \frac{1}{2} \end{array} $	$ \begin{array}{r} 15 \text{ qrs. } 15 \\ 14 : \frac{1}{2} : 1 \text{ or } 18 \\ 7 : \frac{1}{2} : 14 \\ 2 : \frac{1}{2} : 14 \\ 1 : \frac{1}{2} : 2 \text{ lb.} \end{array} $
---	--

So that the Answer to the Question will be found
 to be very near 1266 *l.* 2 *s.* 03 *d.* $\frac{1}{2}$

The Example last-mentioned being (of those
 Questions, which ordinarily happen in Trade) one
 of the hardest to be resolved by the *Rule of Practice*,
 I shall therefore illustrate and explain the foregoing
 Operation, where you may observe the Price of
 218 C. 3 *qrs.* to be found after the Manner of former
 Examples: Then for 24 *lb.* take 14 *lb.* Part of

I 4
the

120 The Rule of Practice.

the 24, I take $\frac{1}{2}$ of the Price of 1 gr. or 28.) Likewise for 7 lb. I take half the Price of 14 lb. and so there yet remains 3 lb. which I divide into two Parts, by saying 2 lb. is the $\frac{2}{7}$ of 14 lb. and 1 lb. the $\frac{1}{7}$ of 14 lb. Lastly, all being added together, the Sum is found to be very near 1266 Pounds, 2 Shillings, 3 Pence and 2 Farthings.

C.	l.	s.	d.
8) 2) 08 of Sugar at 30 :: 13 7 $\frac{1}{2}$ per C.			
173	0	00	00
24	1	00	00
56	3	10	00
584	3	10	00
4	1	00	00
1	0	00	00
589	1	00	00
299 : 00	2	00	00
Answer, 29 l. 09 s. 00 d.			

So that the Answer to the Question will be found to be very near 1266 l. 2 s. 3 d.

The Example last-mentioned being (of those Questions, which ordinarily happen in Trade) one of the hardest to be resolved by the Rule of Practice, I shall therefore illustrate and explain the foregoing Operation, where you may observe the Price of 1 gr. to be found after the manner of former Examples: Then for 24 lb. take 1 lb. Part of the

Another

The Rule of Practice. 121

Another EXAMPLE

C. qrs. lb. l. s. d.
 2) 28 : 1 : 20 at 2 : 15 : 9 $\frac{1}{2}$ per C.
 55

140

140

1540 : 00 : 00

(2) 14 : 00 : 00 Qrs. $\frac{1}{4}$ of the Price.
 (6) 07 : 00 : 00

01 : 02 : 00 mit.
 Qrs. (7) 2) 13 : 11 : 01 : 3 lb. lb.

6 : 11 : 02 : 4 14 : $\frac{1}{2}$ of 28

1 : 11 : 03 : 3 4 : $\frac{1}{2}$ of 28

0 : 11 : 03 : 4 2 : $\frac{1}{2}$ of 4 lb.

158 | 6 : 00 : $\frac{1}{4}$: 3 Mites.

79 | 6 : 00 : $\frac{1}{4}$: 3 Mites.

Answer, 79 l. 06s. 00d. $\frac{1}{4}$ far. 3 mites.

Thus much for the Rule of Practice, which if well understood, you may with a very little Care, shorten all your Accounts whatsoever. The next in Order is the Rule of Three Indirect.

CHAP,

C H A P. IX.

The Rule of Three Indirect.

1. **T**HE Rule of Three Indirect, (or Inverse) is when the fourth Term required ought to proceed from the second Term, according to the same Proportion as the First proceeds from the third.

2. And because many Questions seem very ambiguous, whether they belong to the Rule of Three Direct, or Indirect,

Observe the Directions following.

Direct Proportion is when the greater it is, the greater it requires the fourth Term to be; and the less it requires, the fourth Term must be lesser.

Indirect Proportion is, when that Term by which the Question is made, the greater it is, the less it requires the fourth Term to be; the Less, it requires the fourth Term to be the greater. *Oughtred's Clavis Mathematicæ.*

Or when greater requires greater, and less requires lesser, it is *Direct*: But when greater requires lesser, and lesser greater, it is *Indirect*.

The Rule of Three Inverted 1231

Quest. 1. If 100 Workmen finish a Piece of Work in 12 Days, how many Workmen are sufficient to do the same in 3 Days?

Answer, 400 Workmen.

The given Numbers being thus ranked, multiply the first Term by the second, and divide the Product by the third, for the Quotient shall be your Answer.

$$\begin{array}{r}
 \text{Days} \quad \text{Workmen} \quad \text{Days} \\
 \text{If } 12 \quad 100 \quad 3 \\
 \quad \quad \quad 12 \\
 \quad \quad \quad \hline
 \quad \quad \quad 1200 \\
 3 \overline{) 1200} 400 \text{ Workmen.}
 \end{array}$$

Quest. 2. If 10 Men build a Wall in 20 Days in what Time will 3 Men build it?

$$\begin{array}{r}
 \text{Men} \quad \text{Days} \quad \text{Men} \\
 10 \quad 20 \quad 3 \\
 \quad \quad \quad 10 \\
 \quad \quad \quad \hline
 \quad \quad \quad 100 \\
 3 \overline{) 100} 66 \frac{2}{3} \\
 \quad \quad \quad 18 \dots
 \end{array}$$

Here more being required, 3 the lesser extreme is the Divisor.

$$\begin{array}{r}
 100 \\
 + 20 \\
 \hline
 120 \\
 + 18 \\
 \hline
 138 \\
 \hline
 2
 \end{array}$$

For the shorter the Time, the more must be the Workmen.

Quest. 3.

124 The Rule of Three Indirect

Quest. 3. How many Ells *Engl* of Ell Breadth will line 20 Yards of 3 Quarters broad.

Answer, 9 Ells $\frac{1}{2}$ *Engl*.

grs. *Yards* *Days*

$$\begin{array}{r} 3 \text{ Yards} \\ 20 \text{ Yards} \end{array} \quad \begin{array}{r} 9 \text{ Ells} \\ 18 \text{ Ells} \end{array}$$

4

The given numbers being thus ranked, multiply the first Term by the second, and divide the Product by the third, the Quotient shall be your Answer.

Answer. 9 Ells *Engl*.

$$20 \times 9 = 180 \div 20 = 9$$

$$20 \times 9 = 180$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

$$180 \div 20 = 9$$

Quest. 4. If 100 *l.* in 12 Months gain 10 *l.* for the Interest thereof, I demand what Principal will gain the same Interest in 8 Months?

Months *l.* *Months*

$$\begin{array}{r} 12 \text{ Months} \\ 100 \text{ l.} \end{array} \quad \begin{array}{r} 10 \text{ l.} \\ 12 \text{ Months} \end{array}$$

$$100 \times 12 = 1200$$

$$1200 \div 10 = 120$$

$$120 \times 8 = 960$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

$$960 \div 12 = 80$$

For the shorter the Time, the more must be the Principal to gain the same Interest.

Quest. 5.

The Rule of Three Indirect. 125

Quest. 3. If for the matting of a Room there is required 100 Yards of a Yard broad, how many Yards will be required of $\frac{1}{2}$ Yard and $\frac{1}{3}$ broad.

Answer 66 Yards $\frac{2}{3}$.

$$\begin{array}{r}
 \text{Yard} \qquad \qquad \text{Yards} \qquad \qquad \text{Yard} \qquad \text{Qrs.} \\
 \hline
 1 \qquad \qquad \qquad 100 \qquad \qquad \qquad 1 : 2 \\
 4 \qquad \qquad \qquad 4 \qquad \qquad \qquad 4 \\
 \hline
 4 \qquad \qquad \qquad 400 \qquad \qquad \qquad 6 \\
 \hline
 6)400(66 \frac{2}{3} | \frac{2}{3} \\
 \quad 4
 \end{array}$$

Quest. 6. A Regiment of Soldiers consisting of 1000 Men, are to have new Coats, and each Coat to contain 2 Yards, 2 Quarters of Cloth that is 5 Quarters wide, and they are to be lin'd with Shalloon that is 3 Quarters wide, I demand how many Yards of Shalloon will line them?

Yards Qrs. Men
 2 : 2 10000
 4 10
 ————
 10 10000 Quarters.

Qrs. Qrs Quarters
 5 ——— 10000 ——— 3
 5
 ——— Qrs.
 3) 50000 (16666 $\frac{2}{3}$

 2
 ——— Qrs. Yards
 16666 $\frac{2}{3}$ = 4166
 Yards

Answer, 4166 $\frac{1}{4}$ of Shalloon.

Quest. 7.

126 The Rule of Three Inverted.

21. *Quest.* How much Money must I lend for 12 Months, to requite my Friend who lent me 730 Pounds for 6 Months.

Answer, 365 l.

Months	l.	Months
6	730	12
1	6	1
12	4380	
	36	
	78	
	72	

(365 Pounds.

By lending me a greater Sum for a less Time, I must lend him a less Sum, for a longer Time.

Quest. 8. If an Acre of Land be 4 Perches broad, the Length by Consequence must be 40. Now if the Breadth be 8 Perches $\frac{1}{2}$, what Length must I have to make an Acre.

Perches broad	p. long	p. broad.
4	40	8 $\frac{1}{2}$
4	16	4
16	240	34
	40	
	Perches long.	
34	240	18 $\frac{1}{4}$
	34	
	300	
	272	

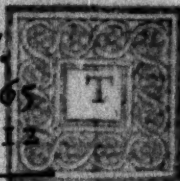
Answer, 18 $\frac{1}{4}$ Perches long.
The

The Rule of Three Indirect. 127

The Proof of the Single Rule of Three Indirect is, if the Product of the fourth Term multiplied by the third, be equal to the Product of the second multiplied by the first, then is the Question rightly performed, if not, erroneous.

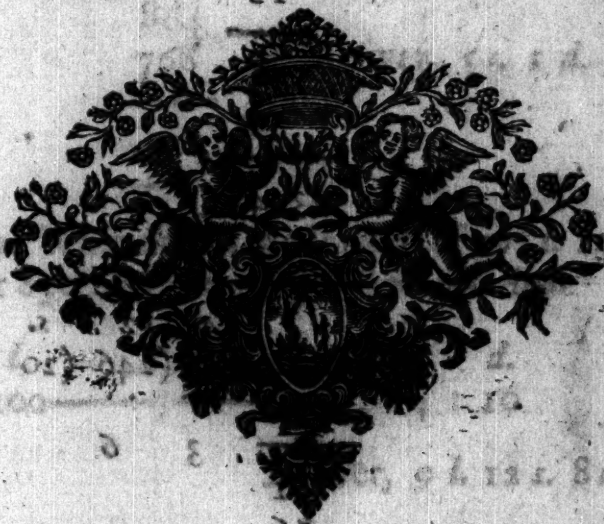
As for Example in the seventh Question.

Months	1	Months	7
4380		4380	
365		365	
730		730	
6		6	



The next Rule in Order is the Double Rule of Three Direct.

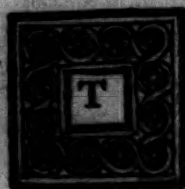
7	Weight	48	lb
12			



C H A P.

CHAP. X.

The Double Rule of Three Direct.



THIS *Direct Rule* is, when both the single Rules do each of them look for a fourth Term in a direct Proportion, and is performed by 2 single *Rules of Three Direct*.

—As for *EXAMPLE*.

Quest. 1. If the Carriage of 7 C. Weight 128 Miles cost 48 Shillings, how much Money must I pay for 3 C. Weight carried 32 Miles after the same Rate. Thus performed :

C. s. C.
If 7 Weight cost 48 — 3

the Length of Carriage will be 40. Now
the Breadth be 8 Paces — 100 Length will
have to make an Area —

576
4
2304
3
7)6912(987(246 (20 6 1/4.
63...
61
56
52
49
3

Quest. 2.

Double Rule of Three Direct. 129

Quest. 1. Then for the second Question, say,

Miles s. d. Miles.
If 128 costs 20 : 6 : $\frac{1}{2}$ what will 32

$$\begin{array}{r}
 12 \\
 \hline
 246 \\
 4 \\
 \hline
 987 \\
 32 \\
 \hline
 1974 \\
 2961 \\
 \hline
 4 \quad 12 \text{ s. } d. \\
 128) 31584 (246(61(5 : 1 \frac{1}{2} = \frac{26}{128} = \frac{13}{64} \\
 256 \dots \dots 60 \\
 \hline
 598 \quad \quad 2 \quad \quad \\
 512 \quad \quad \quad 1 \\
 \hline
 864 \\
 768 \\
 \hline
 96 \\
 \hline
 \end{array}$$

Answer, 5 s. 1 d. $\frac{1}{2}$ $\frac{3}{4}$

Quest. 2. What comes the Interest of 192 l. 14 s. 10 d. unto, for 830 Days at 5 l. per Cent. per Ann.

$$\begin{array}{r}
 l. \quad l. \quad l. \quad s. \quad d. \\
 100 \text{ --- } 5 \text{ --- } 192 : 14 : 10.
 \end{array}$$

Answer, 9 l. 12 s. 8 d. $\frac{1}{4}$

$$\begin{array}{r}
 \text{Days} \quad l. \quad s. \quad d. \quad \text{Days} \\
 \text{Then if } 365 \text{ --- } 9 : 12 : 8 \frac{1}{4} \text{ --- } 830
 \end{array}$$

The final Answer is 21 l. 18 s. 03 d.

K

Quest. 3.

130 Double Rule of Three Direct.

Quest. 3. What comes the Interest of a Bond to of 92 l. 15 s. for 3 Months, 3 Weeks and 4 Days at 6 l. per Cent.

l.	l.	l.	s.
If 100	6	92	15
20	20	20	
2000	120	1855	
		120	

37100
1855

222600

2|000(222|600(11|1

d.
5|11:3 1/2

788

90

Quest. 4. What comes the Interest of 100 l. for 830 Days at 5 l. per Cent. per Ann.

100 ——— 5 ——— 100 : 14 : 10

Answer 9 l. 12 s. 8 d.

Then if 302 ——— 9 : 12 : 8 1/2

Quest. 5. The final Answer is 21 l. 18 s. 09 d.

Days

Double Rule of Three Direct. 131

Then if

Days l. s. d. Days
 365 — 5 : 11 : 3 ½ what will 109

20

12

1335

4

5342

109

48078

53420

4

12

365) 582278 (1595 (398 (13

365

36

l.

s.

d.

3

1

13

2

¼

For Answer.

2172

38

1825

36

3477

2

3285

1928

1825

103

K a

CHAP

Days

The Double Rule of Three Indirect.

Performed by two single Rules.

Quest. 1. **I**F 24 Rods of Brick-work require 4 Men to finish it in 12 Days, how many Men will 384 Rods require to finish it in 48 Days.

	Rods	Men	Rods
Direct	24	4	384
		Men	4
	24)1536(64		
	144		1536
	96		
	96		
	0		
	Days	Then	Days
If	12	64 Men	48 Indirect.
	12		
	48)768(16		
	48		
	288		
	288		
	0		

If one of them happens to be a Rule Indirect, that double Rule is called *Indirect*. Quest.

Double Rule of Three Indirect. 133

Quest. 2. If 100 l. Principal in 12 Months Gain 6 l. Interest, what Principal will gain 3 l. 7 s. 6 d. in 9 Months?

Answer 75 l.

Thus,
 Indirect
 Months l. Months
 12 ——— 100 ——— 9
 12 ——— 100 ——— 9
 Answer, 75 l. Principal.
 9) 1200 (133 $\frac{1}{2}$ = 6 : 8

Principal
 100 l. ——— 36
 12 ——— 27
 36 ——— 30
 27 ——— 27
 30 ——— 30
 27 ——— 27

Quest. 4. Of what Principal was 150 l. gained in 12 Months, when 100 l. in 12 Months Gain 6 l.

Answer, 157 l. 8 s. 6 d.
 If 6 Int. ——— 133 : 6 : 8 ——— 3 : 7 : 6

Reduced is,

Direct
 Pence Pence Pence
 1440 ——— 32000 ——— 810
 810 mult.
 12
 1440) 25920000 (18000 (150|0

75

Answer, 75 l.

134 Double Rule of Three Indirect.

Quest. 3. How long Time was 900 l. gaining 420 l. when 6 l. was gained of 100 in 12 Months?

Answer, 93 Months, $\frac{1}{3}$.

Int. 6 l. Princ. 100 l. Int. 420 l.

Answer, 7000 Principal.

Then if

Principal 7000 l. Months 12 Principal 900 l.

84000 900)84000(93 $\frac{1}{3}$ Part of a Month.

Quest. 4. Of what Principal was 150 l. gained in 19 Months, when 100 l. in 12 Months Gain 6 l.

Answer, 1578 $\frac{1}{9}$ Principal.

Thus,

l. 6 Princ. 100 l. 150 Int.

Answer, 2500 Princip.

Then

Double Rule of Three Indirect. 135

	<i>Then,</i>	
<i>Months</i>		<i>Months</i>
Ind. 12 ——— 2500 Principal ——— 19		
12		11
19)300000(1578 $\frac{1}{19}$. or		
19		1578:18:11 $\frac{1}{4}$ $\frac{2}{19}$.
110		
095		
150		
133		
170		
152		
18		

Quest. 5. If 6 Mowers will mow 45 Acres in 5 Days, how many Mowers will mow 300 Acres in 6 Days?

Answer, 33 Mowers $\frac{1}{3}$.

<i>Acres</i>	<i>Mowers</i>	<i>Acres</i>
45 ——— 6 ——— 300		
		6
		1800

<i>Mowers</i>
45)1800(40
180
00

K 4

Then

136 Double Rule of Three Indirect.

Then,

Days — Mowers — Days
If 5 — 40 — 6

5

Mowers

6)200)33 $\frac{1}{3}$

18

20

18

2

But a more particular Application will be made of the *Double Rule of Three*, and a more compendious working shall be shewn, when I shall come to the *Rule of Simple-Interest*.



C H A P.

CHAP. XII.

The Rule of Fellowship.

Note, *The Rule of Fellowship is either Single or Double.*



TH E Single Rule is, when the Stocks proportioned do continue in the common Bank equal Times, that is to say one Man's Stock continueth as long Time as another.

As for EXAMPLE.

Quest. 1. Two Merchants *A* and *B*. were Sharers in a Parcel of Goods; for the Purchase of which, *A* laid out 13 *l.* 7 *s.* 4 *d.* and *B* 8 *l.* 9 *s.* 3 *d.* Now upon Sale of these Goods they gain 5 *l.* 17 *s.* 5 *d.* I would know what is the Gain of *A*, and what of *B*.

How to work the Single Rule of Fellowship.

Take the Total of all the Stocks, for the first Term in the *Rule of Three Direct*; the whole Gain or Loss, for the second; and the particular Stocks for the third: This done, repeating the *Rule of Three* so often as there are particular Stocks in the Question the fourth Term produced upon those several Operations,

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Single Fellowship.

rations, are the respective Gains or Losses of those Particular Stocks propounded: So in this first Example abovementioned according to the Question.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
<i>A</i> laid out	13	07	4
<i>B</i> laid out	8	09	3

Total 21 16 : 7

So if 21 ; 16 : 7 gain 5 : 17 : 5 what 13 : 7 : 4

	<i>l.</i>	<i>s.</i>	<i>d.</i>	
<i>Facit A</i>	3	11	11	Part.
<i>B</i>	2	05	06	Part.
	5	17	05	In all.

If both the Shares added together make up the whole gains, then is your Question rightly done.

Quest. 2. *A, B, C,* freight a Ship with 70 Tuns of Wine, whereof *A* loaded 30 Tuns, *B.* 24, and *C.* 16 Tuns, by Reason of tempestuous Weather at Sea, they threw overboard 10 Tuns, how much of this Loss must each of these Merchants have?

	<i>Tuns,</i>	
<i>Answer, A.</i>	4	$\frac{2}{7}$
<i>B.</i>	3	$\frac{2}{7}$
<i>C.</i>	2	$\frac{2}{7}$
	10	0

The Fractions make 1 Tun amongst them.

Quest. 2.

Single Fellowship

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Quest. 2. Thus the Operation is performed.

Tuns Tuns Tuns
70 10 30

Value of his share at his Death a-
mounted only into 170 what must each

Man have. 280 D. 70(300(4) $\frac{28}{70} = \frac{2}{7}$ A. Loss.

First Farmer 20 E. 70

Second Farmer 10 F. 10

Tuns Tuns Tuns H. 24

70 10 24 10 10

Proof Tuns 70(240(3) $\frac{28}{70} = \frac{2}{7}$ B. Loss.

Quest. 3. Three Men made a Company.

A. put in 40 £. B. put in 30 £. C. put in 20 £.

in 60 days and they lost 100 £. Demand what each Man

Proof. Tuns: 70 Tuns: 100 Tuns: 160

41: $\frac{2}{7}$ A. 170 100 160 particular Stocks

3: $\frac{1}{7}$ B. 100 100 100 by that which is

2: $\frac{1}{7}$ C. 0 : 70 : 10 : 80 Tuns 70(160(2) $\frac{28}{70} = \frac{2}{7}$ C. Loss.

10 140 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

0 : 00 : 00 : 00 100 100 100 100

Quest. 3. A Debtor dies indebted to 8 Creditors,
viz. To

	L. 01	01	05
A.	100		
B.	86		
C.	75		
D.	60		
E.	54		
F.	32		
G.	24		
H.	15		
In all	446		

The Value of his E-
state at his Death a-
mounted only unto
150 l. what must each
Man have.

Work accordingly by 8 Rules of Three, and you
will find the Quotients thus:

	l.	s.	d.	f.
Unto A.	33	: 12	: 07	: 2
B.	28	: 18	: 05	: 2
C.	25	: 04	: 05	: 3
D.	20	: 05	: 07	: 0
E.	18	: 03	: 02	: 2 + 2
F.	10	: 15	: 02	: 2 + 2
G.	08	: 01	: 05	: 0
H.	05	: 00	: 10	: 3 + 3

In all 150 : 00 : 00 : 0

Quest. 4.

Quest. 4. Three Farmers hired a Shepherd to keep their Sheep for 7*l.* 10*s.* a Year. The first committed 430 Sheep to his keeping, the second 357, and the third 500 Sheep, what must each Farmer pay according to his Proportion

Work as before by the three *Rules of Three Direct*, and you will find

	<i>l.</i>	<i>s.</i>	<i>d.</i>	
First Farmer	2	10	1	+
Second Farmer	2	01	7	+
Third Farmer	2	18	3	+
			1	

facit 1 Penny.

Proof 7 : 10 : 0

Quest. 5. Three Merchants made a Company. *A.* put in 600 *l.* *B.* put in so oftentimes 30*s.* as *A.* put in 40*s.* *C.* put in so oftentimes 70*s.* as *B.* put in 60*s.* and they gained together 500, I demand what each Man must have, and what each Man put in.

In Questions of this Nature, the particular Stocks unmentioned, must be found out by that which is mentioned.

As for Example, to find what Stock B. put in ;

Thus :

$$\begin{array}{r}
 \textit{l.} \qquad \qquad \textit{l.} \qquad \qquad \textit{l.} \\
 4 \text{ --- } 600 \text{ --- } 5 \\
 \qquad \qquad \qquad 5 \\
 \qquad \qquad \text{--- } \textit{l.}
 \end{array}$$

4)3000(750 *B.* put in.

Again,

Single Fellowship.

Again, to find out *C*, then such Reason as *B* hath to the Money, which *B*. put in, such Reason must *C* have to the Money which *C*. put in.

6) 5250(875 l. C. put in

48...

Thus they put in,

A. 600

B. 750

C. 875

45

42

30

30

In all 2225

By three Rules of *Three* & Operation.

Quest. 5. If 2225 gain 500 what 600

500

300000

$$2225)300000(134-\frac{1850}{2225}$$

2225

A.

7750

6675

10750

8900

1850

2225

Single Fellowship.

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$$\begin{array}{ccccccc} l. & l. & l. & l. & & & \\ 2225 & \text{---} & 500 & \text{---} & 750 & \text{---} & 168 = \frac{1292}{2225} B. \end{array}$$

$$2225 \text{ --- } 500 \text{ --- } 875 \text{ --- } 196 = \frac{1420}{2225} C.$$

Answer

Fractions make 2 l.

$$A. \quad 135 + 1850$$

$$B. \quad 168 + 1200$$

$$C. \quad 196 + 1400$$

2

Proof 500

Quest. 6. Three Merchants made a Company D, E, F, whereof D. put in 437 l. E. put in 211 l. and they gained together 562 l. whereof F. must have 187 l. 05 s. I demand D. and E. Shares, and what F. put into Company.

To find what F. put in, subtract his particular Gain from the whole Gain.

$$\begin{array}{r} l. \quad s. \\ 562 : 00 \\ 187 : 05 \\ \hline 374 : 15 \end{array}$$

Then add D and E's Stock together.

$$\begin{array}{r} 437 \quad D. \\ 211 \quad E. \\ \hline 648 \end{array}$$

If

Single Fellowship.

Then say, If $\begin{array}{c} L. \\ 374 \\ 20 \end{array} : 15 \text{ --- } \begin{array}{c} L. \\ 648 \end{array} \text{ Stock --- } \begin{array}{c} L. \\ 187 \\ 20 \end{array} : 15$

7485

3755

648

F. put in.

7485)2433240(325=7485

30040

22455

15020

22530

18774

14970

2433240

38040

37425

615

Then to find D. and E. Part of the Profit.

Say, if

$\begin{array}{c} L. \\ 648 \end{array} \text{ --- } \begin{array}{c} L. \\ 374 \\ 05 \end{array} : 05 \text{ total Stock --- } \begin{array}{c} L. \\ 437 \\ 489 \end{array} D.$
 Answer, 252 l. 07 $\div$ 489.

$\begin{array}{c} L. \\ 648 \end{array} \text{ --- } \begin{array}{c} L. \\ 375 \\ 05 \end{array} : 05 \text{ --- } \begin{array}{c} L. \\ 211 \\ 159 \end{array} E.$
 Answer, 121 l. 17 s. 159.

P R O O F.

Fract. facit 1 s.

D. 252 : 07 + 489

E. 121 : 17 + 159

F. 187 : 15 + 000

562 : 00 + 648 facit. 1 s.

Five

Single Fellowship.

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Five Merchants, viz. A, B, C, D, and E, have gained 2025, which they divide into such Sort, that $\frac{1}{2}$ the Share of A. is equal severally to $\frac{1}{4}$ of the Share of B, $\frac{1}{3}$ of C, $\frac{1}{6}$ of D, $\frac{1}{8}$ of E, the Question is to know what was the Share of each Merchant?

Answer, A. 162 l. B. 324 l. C. 405 l. D. 486 l. and E. 648 l.

Thus found out.

Divide a Number at Pleasure into such Parts, which may be in such Proportion as the Shares required, and proceed according to the subsequent Operation.

A.	2
B.	4
C.	5
D.	6
E.	8
	25

If 25 proceed from 2025—what will 2

Answer, 2=162 for A.

4=324 for B.

5=405 for C.

6=486 for D.

8=648 for E.

For according to the Question,

A. 162 whereof $\frac{1}{2}$ is 81

B. 324 whereof $\frac{1}{4}$ is 81

C. 405 whereof $\frac{1}{3}$ is 81

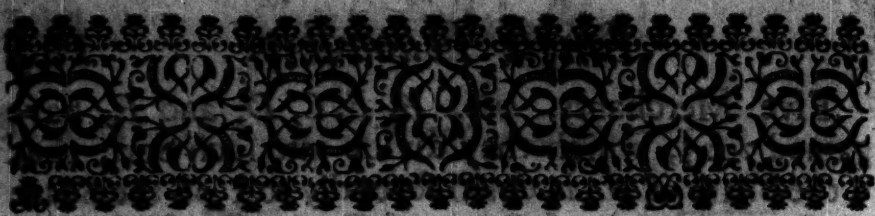
D. 486 whereof $\frac{1}{6}$ is 81

E. 648 whereof $\frac{1}{8}$ is 81

2425 According to the Tenor of the Question for Proof.

L

CHAP.



C H A P. XIII.

The Double Rule of Fellowship.

Definition.



DOUBLE FELLOWSHIP is when the Stocks propounded, are double Numbers, viz. when each Stock hath Relation to a particular Time.

Operation. For the Operation, multiply each particular Stock by its respective Time, and make the total of their Products the first Term; the Gain or Loss, the second; and the said particular Products of the double Numbers, the third Term, and so proceed as before taught.

As for EXAMPLE.

Quest. 1. Three Butchers hired a Piece of Ground for 12 l. 10 s. 06 d. A. put in 20 Oxen for five Days, B. put in 16 Oxen for 7 Days, C. put in 25 Oxen for 4 Days; now what must each of these Butchers pay according to their Proportion.

		Ox-Days
According to the Rule	A. } put in	20—5=100
	B. }	16—7=112
	C. }	25—4=100

312

Then

Double Fellowship.

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Then by the Rule of Three say,

If 312 $\frac{12}{100}$ will 100
Facit 4 l. 0 s. 3 d. + $\frac{1}{3}$. A. pays.

312 $\frac{12}{100}$ will 100
Facit 4 l. 9 s. 11 d. + $\frac{1}{3}$. B. pays.

312 $\frac{12}{100}$ will 100
Facit 4 l. 0 s. 3 d. + $\frac{1}{3}$. C. pays.

PROOF

A. 4-0-3 $\frac{1}{3}$
B. 4-9-11 $\frac{1}{3}$. Fractions 1 d.
C. 4-0-3 $\frac{1}{3}$

Proof 12-10-6

Quest. 2. Three Merchants enter into a Partnership; A. put in 109 l. 5 s. for 3 Months, B. put in 450 l. 7 s. for 4 Months, and C. 147 l. 12 s. for 6 Months, and they gained in a Voyage to the West-Indies 209 l. 7 s. 2 d. I demand each Man's Part.

As by the Operation.

A. 109-5 } mul. 3 327-15	B. 450-7 } mul. 4 1801-8	C. 147-12 } mul. 6 885-12
L 2		A. 327

Double Fellowship.

	<i>l.</i>	<i>s.</i>	
A.	327	: 15	
B.	1801	: 08	
C.	885	: 12	
	3014	: 15	Product.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>
3014	: 15	—	gain 209	: 7 : 2 what 327 : 15
			Facit	22 <i>l.</i> 15 <i>s.</i> 2 <i>d.</i> A.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>
3014	: 15	—	gain 209	: 7 : 2 what 1801 : 8
			Facit	125 <i>l.</i> 1 <i>s.</i> 11 <i>d.</i> B.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>
3014	: 15	—	gain 209	: 7 : 2 what 885 : 12
			Facit	61 <i>l.</i> 10 <i>s.</i> 00 <i>d.</i> C.

PROOF.

<i>l.</i>	<i>s.</i>	<i>d.</i>	Fract.
A.	22	: 15 : 2	A. 31240
B.	125	: 01 : 11	B. 261603
C.	61	: 01 : 00	C. 2592
			59935 = 1 <i>d.</i>
			Proof 209 : 07 : 2

Quest. 3.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
3014	: 15	—	gain 209	: 7 : 2	what 327 : 15
			Facit	22 <i>l.</i> 15 <i>s.</i> 2 <i>d.</i>	A.
3014	: 15	—	gain 209	: 7 : 2	what 1801 : 8
			Facit	125 <i>l.</i> 1 <i>s.</i> 11 <i>d.</i>	B.
3014	: 15	—	gain 209	: 7 : 2	what 885 : 12
			Facit	61 <i>l.</i> 10 <i>s.</i> 00 <i>d.</i>	C.

Double Fellowship.

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Quest. 3. A College in the University hath 20 Fellows, and 30 Scholar, which doth dispend yearly 2600 Pounds; in this Manner, every Fellow hath 5 *l.* for every Scholar 1 *l.* how much of this Revenue yearly belongs to the Fellows, and how much to the Scholars?

	<i>l.</i>	
Answer, to the Fellows	2000	
To the Scholars	600	
	2600	

Thus found.

	<i>l.</i>	
20 Mult. by 5 <i>l.</i>	100	<i>facit</i>
30 Mult. by 1 <i>l.</i>	30	<i>facit</i>
	130	

Then

	<i>l.</i>	
130 — 2600 — 100	2000	<i>Facit</i> Fellows,
130 — 2600 — 30	600	<i>Facit</i> Scholars.

Quest. 4. Two Merchants, *A.* and *B.* are in Partnership; the Sum of their Stocks are 300 Pounds; the Money of *A.* continued in Company 9 Months, the Money of *B.* 11 Months, they gained 200 Pounds, which they divided equally; the Question

L 3

is,

Double Fellowship

is to know how much each Merchant did put in

Answer, *A.*—165
B.—135

300 Stock.

Thus found, divide 300 into two such Parts, as may be in Proportion as 11 is to 9, so will the greater Part be the Stock of *A.* and the lesser *B.* which Stocks being multiplied by their respective Times, the Products will be equal.

11 } multiplied.
9

Then if 20 give 300 what 11. Answer 165 for *A.*

20 — 300 — 9 Answer, 135 for *B.*

PROOF.

165 *A.*
135 *B.*

300

Quest. 5. Three Merchants, *A, B, C*, enter Partnership, and agree to continue in a joint Adventure 16 Months. *A.* puts into the common Stock at the Beginning of the said Term 100 Pounds, and at 8 Months End he takes out 40 Pounds, and 4 Months after such taking out he puts in 140 Pounds. *B.* put in at first 200 Pounds, and at 6 Months End, he puts in 50 more, and at 4 Months after the putting in

Double Fellowship

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in of the said 50 Pounds, he takes out 100 Pounds. C. puts in at first 150 Pounds, at 4 Months End he takes out 50 Pounds, and at 8 Months after such taking out, puts in 100 Pounds. Now at the End of the said 16 Months they had gained 357 Pounds, the Question will be to know, how much of the said Gain belongs to each Merchant.

Note, That in all such Questions as these, you must carefully first observe the whole Time of Partnership, which is here 16 Months. Secondly, The respective Time, belonging to each Man's private Stock, as you may observe in the Operation as followeth, viz.

First Merchant. A. had 100 *l.* in the common Stock for 8 Months, therefore

800

100 multiplied by 8 is 800

Also 60 *l.* for 4 Months is

240

240

Also 200 *l.* for 4 Months is 800

800

200

4

The Total of the Products of Money and Time for *A.* is

1840

800

Second Merchant. B. had 200 *l.* in common Stock for 6 Months, therefore

1200

200 multiplied by 6 is 1200

250

4

Also 250 *l.* for 4 Months is 1000

1000

Also 150 *l.* for 6 Months is 900

150

6

The Total of the Products of Money and Time for *B.* is

3100

900

L 4

Third

Third Merchant. C. had 150 l. in the com-
mon Stock for 4 Months, therefore

150 multiplied by 4 is

Also 100 l. for 8 Months is

600

Also 200 l. for 4 Months is

800

The total of the Products of Mo-
ney and Time for C. is

200

4

800

The Question continued, thus adding the said
3 Totals together, viz.

A. 1840
B. 3100
C. 2200

add.

Sum is 7140

Wherefore say by the Rule of Three Direct, 7140 is
to the total Gain 357 l. so is 1840 l. to 92 l. the
Gain of A. Again, as 7140 l. is to 357 l. so is
3100 l. to 155 l. the Gain of B. Lastly, as 7140 l.
is to 357, so is 2200 l. to 110 l. the Gain of C.

As

Double Fellowship.

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A's Part is 927
 B's Part is 155 } add.
 C's Part is 1108

Total is 357

The PROOF

This Rule is proved by the adding of the Terms required, whose Sum ought to be equal to the second Term in the Question, otherwise the whole Work is erroneous.



CHAP.

CHAP. XIV.

BARTER.

DEFINITION.



BARTER, is the exchanging Wares for Wares, or one Commodity for another.

As for EXAMPLE.

Two Merchants barter, *A*. hath 3 C. 2 qrs. of Pepper at 13 *d.* $\frac{1}{2}$ per lb. *B*. hath Ginger at 15 *d.* $\frac{1}{4}$ p. lb. I would know how much Ginger must be delivered for the Pepper?

Thus found.

1. If 1 lb. of Pepper cost 13 *d.* $\frac{1}{2}$ what will 3 C. 2 qrs.

4	—	4
54	—	14
		28
		—
12		112
4)21168(5292(4413		28
... 48 ...		—
— 22 — 03		392
49		54
48		—
—		1568
12		1960
12	Answer, 22 l. 3 s.	—
—	Pepper.	21168

2dly,

BARTER

153

2^dly, If 15 d. 4 buy 1 of Ginger, what will 22: 3

4 20
61 443
12

61)21264(348 + 1/4
183: Ginger.

5316
4

296
244

21264

524
488 Answer 348 = 1/4. Pounds of
Ginger, must be delivered for
36 the Pepper.

Quest. 2. How much Sugar at 8 d. per lb. may be bought for 20 C. of Tobacco, at 3 l. per 112 lb. Weight?

C. l. C.
1 of Tobacco 3 20

Facit 60.

8 buy 1 lb. of Sugar, what 60: 0: 0

20
1200
12
8)14400(1800
8...
64
64
00

Answer, 1800 Pounds of Sugar.

Quest. 3.

Quest. 3. 20 C. of Brasil is given for 43 C. of Cooperas at 8 s. p. C. what Price must each hundred of Brasil bear.

Answer, 17 s. $\frac{1}{3}$.

Thus found,

43 at 8
8

34|4

17|4

C.

h. s.

C.

If 20 of Brasil — 17 : 4 what 1

20

344

20)344(17 — $2\frac{1}{3}$

20

144

140

4

Quest. 4 A. hath 100 Pieces of Silks, which are worth but 3 l. apiece in ready Money, yet he barterers them with B. at 4 l. per Piece, and at that Rate takes their Value of B. in Wools at 7 l. 10 s. per Hundred, which are worth but 6 Pounds per C. in ready Money : The Question will be to know, what Quantity of Wool pays for the Silks, and which of the Two, A. or B, is the Gainer, and how much?

Answer, 53 C. $\frac{1}{3}$ of Wools pay for the Silks, and A. gaineth 20 Pounds in Money by the Barter.

Thus

BARTER.

I 57

Thus found,

1. If $7 : 10$ ——— become 6 what will 400

Facit 320 l.

2. If 6 ready Money buy 1 of Wool, what 320 ready Money?

Answer, 53 C. $\frac{1}{3}$ of Wools.

So it is evident, that the true Weight of the Wool which *B.* delivered was 320 *l.* for which he received only of *A.* the Worth of 300 *l.* in Silks, and therefore *B.* loofeth 20 *l.* by the Barter.

Quest. 5. When Cinnamon at 4 s. ready Money is bartered at 5 s. and Cotton at 14 d. per Yard, is barter'd for the Cinnamon, what must the Yard be sold for in Barter to loose 10 l. in every 100 l.

Answer, 15 d. $\frac{3}{4}$.

Thus found,

First, If $\overset{s.}{4}$ in Barter for $\overset{s.}{5}$ what must $\overset{d.}{14}$

$$\begin{array}{r}
 12 \\
 \hline
 48 \\
 \hline
 12 \\
 \hline
 60 \\
 \hline
 4 \\
 \hline
 240 \\
 \hline
 14 \\
 \hline
 960 \\
 \hline
 240 \\
 \hline
 4 \\
 \hline
 48)3360(70 : 17 \frac{1}{2} \\
 \underline{336} \cdot \cdot \\
 \hline
 2 \\
 \hline
 00
 \end{array}$$

Secondly,

l. d. *l. d.* *d.*

Secondly, If 100 become 90 what 17 : $\frac{1}{2}$.

Answer, 15 d. $\frac{1}{4}$.

Quest. 6. *A.* hath Camblets at 50 s. per Piece ready Money, which he barterers at 3 *l.* to what Price must *B.* raise Silk at 21 s. per lb. to equal the Barter, when he pays $\frac{1}{3}$ ready Money.

s.	s.	s.	s.
60	If 30	40	21
20 subtr		21	
<u>40 s.</u>		<u>40</u>	
		80	

30)840(28 For Answer

60

240

240

240

0

Quest. 7. *A.* barterers with *B.* for Cloves at 6 s. for 7 s. 6 d. per lb. and loses 10 *l.* per Cent. to have $\frac{1}{3}$ ready Money, what's the just Price of a Yard of Velvet, delivered at 22 s. to equal the Barter?

Answer, 18 s. : 8 d. + $\frac{1}{3}$ of a Penny.

s.	d.
$\frac{1}{3}$ of 7	6
is 2	6

rest 5 : 0

s.	d.
If 100 loose 10	what 7 : 6

Answer, 9 d.

Then

BARTER.

159

Then 2 : 6
From 6 : 9

Rest 4 : 3

If $\begin{array}{r} s. \quad d. \\ 5 \quad 4 : 3 \end{array}$ $\begin{array}{r} s. \quad d. \\ 4 \quad 3 \end{array}$ $\begin{array}{r} s. \quad d. \\ 3 \quad 22 \end{array}$

$\begin{array}{r} 12 \\ 51 \end{array}$ $\begin{array}{r} 51 \\ 22 \end{array}$

$\begin{array}{r} 110 \end{array}$

1122

Pence

3)1122(224

12)224(18 : 8 $\frac{2}{3}$

104

96

8



CHAP.

C H A P. XV.

Rebate or Discount of Money.

Definition.



RE B A T E is the Payment of so much ready Money, in Lieu of a Sum due at any Time to come, which put forth at Interest for any such Time, would become equal to that Sum so due at any Time to come.

As for E X A M P L E.

Quest. 1. A Merchant who is to receive 1680 *l.* at 9 Months End, desires to have his Money immediately paid him, for which Courtesy he is willing to abate 8 *per Cent. per Ann.* Interest; the Question is to find how much present Money is equivalent to 1680 *l.* rebating 8 *l. per Cent.*

The R U L E is,

As 1 Year or 12 Months, or 365 Days, is to the Rate of Interest proposed, so is the Time proposed the third Term, to find the fourth Number sought.

<i>Months</i>	<i>l.</i>	<i>Months</i>	<i>l.</i>
1. So if 12	8	9	<i>Facit</i> 6

Then

C H A P.

REBATE

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Then if 106 Rebate come from 100 what will 1680

$$106)168000(1584 + \frac{324}{100}$$

106

620

530

900

848

520

424

96

Answer, 1584 : 18 : 6 $\frac{3}{4}$

$\frac{324}{100}$ facit 18 : 6 $\frac{3}{4}$

Which said 1584 *l.* 18 *s.* 6 *d.* $\frac{3}{4}$, which is the present Money the Merchant must receive, being deducted from 1680: there remaineth the Money rebated, viz.

95 : 01 : 05 $\frac{1}{4}$

1680 : 00 : 00

1584 : 18 : 06 $\frac{3}{4}$

Subtract

95 : 01 : 05 $\frac{1}{4}$

Money rebated.

M

Quest. 2

Quest. 2. How much present Money is equivalent to 3496 Pounds payable at the End of 25 Months at the Rate of 6 l. Interest-Rebate.

Answer, to receive in present Money, } 3107 : 11 : 1 + $\frac{1}{3}$!

Thus,

	<i>Months</i>	<i>l.</i>	<i>Months</i>	<i>l.</i>	<i>s.</i>
1.	If 12	6	25		
				<i>Facit</i>	12 : 10

	<i>l.</i>	<i>s.</i>	<i>l.</i>	<i>l.</i>
2d,	Then if 112 : 10	100	3496	
	<i>Answer,</i>	3107 l.	11 s.	1 d. $\frac{1}{3}$.

Quest. 3. Sold Goods for 795 l. 11 s. 2 d. to be paid at $\frac{2}{3}$ Months, (that is half at three Months, and the other half at 3 Months after that :). But the Merchant desiring to be paid for his Goods presently, is content to discount at 6 l. per Cent. per Ann.

In Questions of this Nature you are to divide the given Sum into two Parts, according to the time of Payment.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
2)	795	11	2

	<i>l.</i>	<i>s.</i>	<i>d.</i>
	397	15	7

	<i>Months</i>	<i>l.</i>	<i>Months</i>	<i>l.</i>	<i>s.</i>
1.	12	6	3		
				<i>Facit</i>	1 : 10

	<i>l.</i>	<i>s.</i>	<i>l.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
2d,	101	10	100	397	15	7
	<i>Facit</i>	391 l.	18 s.	1 d.		

REBATE.

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Then for the second Payment.

Months $\frac{1}{12}$ — $\frac{1}{6}$ — Months $\frac{1}{6}$ — Facit 3

$\frac{1}{103}$ — $\frac{1}{100}$ — $\frac{1}{397}$: 15 : 7
Facit 386 l. 3 s. 11 d.

So that 397 : 15 : 7 for 3 Months — 5 : 17 : 6

397 : 15 : 7 for 6 Months — 11 : 11 : 8

All the Rebate is 17 : 09 : 2

Therefore from 795 : 11 : 2
Rebate 17 : 09 : 2

778 : 02 : 0

Thus the Money to be paid presently is 778 l. 2 s.
for Answer.

Quest. 4. I demand the Discount of 760 l. 16 s.
for $\frac{3}{4}$ Months after the Rate of 6 l. per Cent. Simple-
Interest.

Thus work,

If 12 Months be

6 l.

Months $\frac{1}{12}$ —

Then 4 : — is 2

8 : — is 4 l.

12 : — is 6 l.

$\frac{3}{4}$) 760 : 16

253 : 12

253 : 12

253 : 12

760 : 16

M 2

1st.

1st. Then if $\begin{array}{ccc} l. & l. & l. \end{array} \begin{array}{c} 102 \\ 100 \\ 253 \end{array} : 12$

$\begin{array}{ccc} l. & s. & d. \end{array}$
Facit 248 : 2 : 6 for the first Payment at
 4 Months.

2d. If $\begin{array}{ccc} l. & l. & l. \end{array} \begin{array}{c} 104 \\ 100 \\ 253 \end{array} : 12$

$\begin{array}{ccc} l. & s. & \end{array}$
Facit 243 : 16 for the second Payment at
 8 Months.

3d. If $\begin{array}{ccc} l. & l. & l. \end{array} \begin{array}{c} 106 \\ 100 \\ 253 \end{array} : 12$

$\begin{array}{ccc} l. & s. & \end{array}$
Facit 239 : 4 for the third Payment at
 12 Months.

$\begin{array}{ccc} l. & s. & d. \end{array}$
 248 : 02 : 6 First Payment.

243 : 16 : 0 Second Payment.

239 : 04 : 0 Third Payment.

731 : 02 : 6 The ready Money to be paid.

$\begin{array}{ccc} l. & s. & d. \end{array}$
 From 760 : 16 : 0
 Subt. 731 : 02 : 6

29 : 13 : 6 To be rebated.

$\begin{array}{ccc} l. & s. & d. \end{array}$
 The Answer is 731 : 2 : 6 to be paid presently.

Quest. 5.

Quest. 5. If 360 l. 12 s. be payable at the End of 163 Days to come, how much present Money will discharge the said Debt by rebating after the Rate of 5 l. per Cent. per Ann.

Days 1. Days
If 365 — 5 — 162

l. s. d.

Answer, 2 : 4 : 4 $\frac{1}{2}$.

l. s. d. l. l. s.
Then, If 102 : 4 : 4 $\frac{1}{2}$ — 100 — 360 : 12.

Far. Far. Far.
98128 — 96000 — 346176

Multiply and Divide according to Rule,

l. s. d. far.
Facit 352 : 15 : 7 : 0 present Money to be paid.

Quest. 6. How much present Money must be paid for 400 l. payable in this Manner, viz.

l. l.
200 at 8 Months } Rebating 8 per Cent.
140 at 6 Months } per Ann. Simple In-
60 at 2 Months } terest.

l. s. d.
Answer 383 : 13 : 11 $\frac{1}{4}$ $\frac{1}{2}$

Thus,

Months l. Months l. s. d.
12 — 8 — 8 Facit 5 : 6 : 8
12 — 8 — 6 Facit 4 : 0 : 0
12 — 8 — 2 Facit 1 : 6 : 8

M 3

Then

Then per the Rule of Three.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
105	6	8	100	200	Facit 189 : 17 : 5 $\frac{1}{2}$
104	0	0	100	140	Facit 134 : 12 : 3 $\frac{1}{2}$
101	6	8	100	60	Facit 59 : 04 : 2 $\frac{1}{2}$

For Answer, 383 : 13 : 11 $\frac{1}{2}$

Quest. 7. How much present Money is equivalent to a Rent or Annuity of 100 *l.* a Year to continue five Years, rebate being made at the Rate of 6*l.* for 100 *l.* for one Year Simple Interest.

				<i>l.</i>	<i>s.</i>	<i>d.</i>
1	106	: 100	: 100	<i>Facit</i>	94	: 06 : 00
2	112	: 100	: 100	<i>Facit</i>	89	: 05 : 06
3	118	: 100	: 100	<i>Facit</i>	84	: 08 : 00
4	124	: 100	: 100	<i>Facit</i>	80	: 12 : 02
5	130	: 100	: 100	<i>Facit</i>	76	: 18 : 1 $\frac{1}{2}$

425 : 18 : 09 $\frac{1}{2}$ very
near.

So that by this Question and others before, it is manifest there must be computed the present worth of 100 *l.* due at the first Year's End, also the present Worth of 100 *l.* due at the second Year's End ; and in like Manner, the third, fourth and fifth Years, all which particular present Worth being added together, the Sum will be the Total above propounded.

Viz. 425 : 18 : 9 $\frac{1}{2}$ very near.

C H A P.

CHAP. XVI.

Simple-Interest.



SIMPLE-INTEREST is that which ariseth or is computed from the Principal only, and here all Questions are done by the double Rule of Three Direct or the Rule of Practice.

As for **EXAMPLE.**

Quest. 1: What will the Interest of 475 l. 11 s. 6 d. come to for a Year, at the Rate of 5 Pounds per Cent.

l. s. d.
If 100 gain 5 what will 475 : 11 : 6

20

20

2000

9514

12

12

24000

19022

9511

114132

5

570660

M 4

24/000

$$\begin{array}{r} \text{l.} \quad \text{s.} \quad \text{d.} \\ 24 \overline{) 1000} 570 \text{ l. } (23 : 15 : 6 \end{array}$$

48

90

72

18

20

$$24 \overline{) 378} (15$$

24

138

122

18

12

— d.

$$24 \overline{) 216} (9$$

216

Answer, 23 l. 15 s. 6 d.

The same Sum a shorter Way by *Practice*.

The RULE.

Multiply the Principal by the Rate of Interest, per Cent. per Annum, and the Product, (casting of two Figures on the Right-hand) is the Interest for one Year, from whence 'tis found for any Time required.

Thus,

Simple-Interest.

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Thus,

$$\begin{array}{r}
 \text{l.} \quad \text{s.} \quad \text{d.} \\
 475 : 11 : 06 \\
 \hline
 23 \overline{) 77 : 17 : 06} \\
 \underline{20} \\
 15 \overline{) 57} \\
 \underline{12} \\
 6 \overline{) 90}
 \end{array}
 \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{multiply.}$$

Quest. 2. What is the Interest of 571 l. 15 s. for 8 Months at 6 l. per Cent. per Ann.

By the Double Rule of Three Direct.

$$\begin{array}{r}
 \text{l.} \quad \text{l.} \quad \text{l.} \quad \text{s.} \quad \text{d.} \\
 \text{If } 100 \text{ --- } 6 \text{ --- } 571 : 15 : 0
 \end{array}$$

$$\begin{array}{r}
 \text{l.} \quad \text{s.} \quad \text{d.} \\
 \text{Answer, } 34 : 6 : 1
 \end{array}$$

$$\begin{array}{r}
 \text{Months} \quad \text{l.} \quad \text{s.} \quad \text{d.} \quad \text{l.} \\
 \text{Then if } 12 \text{ --- give } 34 : 6 : 1 \text{ --- what will } 8
 \end{array}$$

$$\begin{array}{r}
 \text{l.} \quad \text{s.} \quad \text{d.} \\
 \text{Answer, } 22 : 17 : 4 \frac{1}{4}
 \end{array}$$

Quest. 3. How much Money will 567 l. 10 s. come to in nine Years after the Rate of 6 l. per Cent. Simple-Interest?

$$\begin{array}{r}
 \text{l.} \quad \text{s.} \quad \text{d.} \\
 \text{Answer } 306 : 9 : 0
 \end{array}$$

Thus,

Thus,

$$\begin{array}{r} \text{L} \quad \quad \quad \text{l.} \quad \quad \quad \text{l.} \quad \text{s.} \\ 100 \text{ --- } 6 \text{ --- } 567 : 10 \end{array}$$

$$\begin{array}{r} \text{L} \quad \text{s.} : \text{d.} \\ \text{Facit } 34 : 1 : 0 \end{array}$$

Then,

$$\begin{array}{r} \text{Tear} \quad \quad \text{l.} \quad \text{s.} \quad \text{d.} \quad \quad \text{Years;} \\ \text{If } 1 \text{ gain --- } 34 : 1 : 0 \text{ --- what will } 9 \end{array}$$

$$\begin{array}{r} \text{--- } \text{l.} \quad \text{s.} \quad \text{d.} \\ \text{Facit } 306 : 9 : 0 \end{array}$$

Quest. 4. What Principal or Sum of Money being put out to Interest for 9 Years will amount unto, or raise a Stock of 873 *l.* 19 *s.* at 6 *l.* per Cent. per Ann.

$$\begin{array}{r} \text{l.} \quad \text{s.} \\ \text{Answer } 567 : 10 \end{array}$$

Thus,

$$\begin{array}{r} \text{Tear} \quad \quad \text{l.} \quad \quad \quad \text{Years} \\ 1 \text{ --- } 6 \text{ --- } \text{what will } 9 \end{array}$$

Answer, 54 Pounds,

$$\begin{array}{r} \text{l.} \quad \quad \quad \text{l.} \quad \quad \quad \text{l.} \quad \text{s.} \\ \text{If } 54 \text{ --- } 100 \text{ --- } 873 : 19 \end{array}$$

Answer, 1135 0 *Shill.*

$$\begin{array}{r} \text{l.} \quad \text{s.} \\ \text{Answer, } 567 : 10 \end{array}$$

$$\begin{array}{r} 567 | 10 \end{array}$$

Quest. 5.

Simple-Interest.

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Quest. 5. Suppose a Debt of 873 *l.* 19 *s.* were not to be paid until 9 Years hence, what would it be worth in ready Money, the Creditor allowing the Rate of 6 *l.* per Cent. Discount to the Debitor?

l. *s.*
Answer, 567 : 10

Quest. 6. At what Rate of Interest per Cent. will 567 *l.* 10 *s.* raise a Stock, or amount to 873 *l.* 19 *s.* in 9 Years Time.

l. *s.* *l.* *s.* *l.*
If 567 : 10 gain 306 : 9 Interest what will 100
reduced into Shillings.

108 | 0 *Shill.*

Will make 54 *l.* Int:

Years *l.* *Year*
Then if 9 come to ——— 54 ——— what will 1

l. *l.*
9) 54 (6 Answer, 6

Quest. 7. Again, In what Time will 567 *l.* 10 *s.* amount unto or raise a Stock of 873 *l.* 19 *s.* at 6 *l.* per Cent. per Ann.

Answer 9 Years,

Thus found,

l. *l.* *l.* *s.*
If 100 gain ——— 6 ——— what will 567 : 10

Reduced to Shillings are $\frac{6 \times 567 \times 10}{2000}$

l. *s.*
34 : 1

Which 68100 Shillings divided by 2000.

2000

$$2000)68100(34-\frac{1}{2}\frac{100}{1000}=1$$

6000

8100

8000

100

Then to find the Years say,

l.	s.	Year	l.	s.
If 306	:	9	require 1	what will 34
20			20	:
6129			681	

681)6129(9 Years for Answer:

6129

0

NOTE well,

If the Work of these four last Examples, viz. Question the third, fourth, fifth and sixth Examples, and the Rules by which they are performed, be well understood, they will be sufficient (notwithstanding there is really but one Question, only they are varied according to the several Cases) to shew how any Question of the like Kind may be truly resolved at any proposed Rate of *Simple-Interest*, especially if the Time given or sought does consist of com-

Simple-Interest.

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complete or whole Years. But if the Time given or sought, does not consist of whole Years, as most generally it does not, it being either less than a Year or more ; then the *Double Rule of Three Direct* performs those Questions much more easily and plainly, than any Operation ; as shall appear in the following Pages.

Quest. 8. What comes the Interest of 192 l. 14 s. 10 d. 100 for 830 Days, at 5 l. per Cent. per Ann.

l. s. d.
Answer, 25 : 11 : 3 + $\frac{1}{3}$.

Thus, First ;

l. s. d.
100 ——— 192 : 14 10

Facit 2698 Pence, or 11 l. 4 s. 10 d. + $\frac{2}{4}$.

Then,

Days Pence Days
If 365 ——— 2698 ——— 830

l. s. d.
Facit 6135 Pence, or 25 : 11 : 3 + $\frac{6}{10}$.

l. s. d.
Answer, 25 : 11 : 3 + $\frac{6}{10}$ + $\frac{1}{3}$.

Quest. 9.

Quest. 9. What is the Interest of 1000 *l.* put in-
to the Bank of England, and taken out at 146 Days
Time, at 5 per Cent. per Ann.

Answer, 20 *l.*

$$\begin{array}{ccc} \textit{l.} & & \textit{l.} \\ 100 & \text{---} & 5 & \text{---} & 1000 \end{array}$$

Answer, 50 *l.*

$$\begin{array}{ccc} \textit{Days} & & \textit{l.} & & \textit{Days} \\ 365 & \text{---} & 50 & \text{---} & 146 \end{array}$$

Answer, in Pence 4800, which is in Shil-
lings 400 *s.* and in Pounds 20 *l.*

Quest. 10. I demand the Interest of 572 *l.* for
75 Days at 5 *l.* per Cent. per Ann.

Answer, 5 *l.* 17 *s.* 6 *d.* $+\frac{4\frac{1}{2}}{32}$.

$$\begin{array}{ccc} \textit{l.} & & \textit{l.} \\ 100 & \text{---} & 5 & \text{---} & 572 \end{array}$$

5

2860

100)2860

Answer, 28 *l.* $+\frac{4\frac{1}{2}}{32}$ or 12 *s.*

Days

Simple-Interest.

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Days 365 ——— 1. 28 : 12 ——— Days 75

20

572

12

1444

572

6864

75

34320

48348

12

365) 514800 (1410 (117

150

6

517 : 6 + $\frac{1}{2}$ $\frac{2}{3}$



C H A P.

CHAP. XVII.

Compound-Interest.



COMPOUND-INTEREST, or *Interest* upon *Interest*, increaseth not only from the Principal, but also from the *Interest* thereof.

This Sort of *Interest* is commonly worked by *Decimal Arithmetick*.

But for the better understanding of it, I shall state a few *Questions* to be performed by *Vulgar Arithmetick*.

As for EXAMPLE.

Quest. 1. So if 300 *l.* be put out at 6 *l. per Cent. per Annum*, reckoning *Interest* upon *Interest*, what what is the *Money* I must receive then?

$$\begin{array}{r} \text{l.} \quad \text{l.} \\ 300 \text{ at } 6 \text{ per Cent.} \\ \underline{6} \\ 18|00 \\ \hline \end{array}$$

$$\begin{array}{r} \text{l.} \quad \text{s.} \quad \text{d.} \\ 300 : 00 : 00 \text{ Principal.} \\ 18 : 00 : 00 \text{ Interest.} \\ \hline \end{array}$$

$$\begin{array}{r} 318 : 00 : 00 \text{ Increase the first} \\ \hline \text{Year.} \end{array}$$

Compound-Interest.

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l. s. d. l.
318 : 00 : 00 at 6
6

19 | 08 : 00 : 00
20

1 | 60
12

7 | 20
4

0 | 80

l. s. d.
318 : 00 : 00
19 : 01 : 07

337 : 01 : 07 Increase the 2d Year

l. s. d. l.
337 : 01 : 07 at 6 per Cent.
6

20 | 22 : 09 : 06
20

4 | 49
12

5 | 94
4

3 | 76

l. s. d.
337 : 01 : 07
20 : 04 : 05 $\frac{1}{4}$

357 : 06 : 00 $\frac{1}{4}$ Increase Third

N 357

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l. s. d. l.
357 : 06 : 00 $\frac{1}{4}$ at 6 per Cent.
6

21	43	:	16	:	04	$\frac{1}{2}$
	20					
8	76					
	12					
9	16					
	4					
0	66					

l. s. d.
357 : 06 : 00 $\frac{1}{4}$
21 : 08 : 09

378 : 14 : 09 $\frac{1}{4}$ Fourth Year.

So that at the fourth Year's End he must receive for Principal and Interest 378 l. 14 s. 9 d. $\frac{1}{4}$.

This Way of Operation is a briefer or more compendious Way than by the *Rule of Three*, which will prove very tedious.

First State your Question as before.

If 100 gain 6 what will 300 your Principal.

Multiply first your Principal by your Interest, that done cut of the two first Figures towards your Right-hand of the Pounds with a Line.

Then multiply them by 20, 12, and 4, and all above two Figures towards your Right-hand, carry over the Line to the Left, as you see in this first Example.

A few

Compound-Interest

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A few Examples to those who understand the Rule of Practice, it will prove easy.

A second Example shall be this,

What comes the Interest of 2456 l. 10 s. at 5 l. per Cent. for three Years, reckoning Interest upon Interest.

2456 : 10 : 00 at 5 per Cent.

5

122 | 82 : 10 : 00

l. s. d.

20

2456 : 10 : 0 Principal.

122 : 16 : 6 Interest.

16 50

2579 : 06 : 6 Increase the first Year.

12

6 00

2579 : 06 : 06 at 5

5

128 | 96 : 12 : 06

l. s. d.

20

2579 : 06 : 06

128 : 19 : 03

19 32

2708 : 05 : 00

12

Increase the second Year.

3 90

4

3 60

N 4

2708

A few Examples to the whole of the
Rate of Interest it will prove at 5
2708 : 05 : 09 : 4 at 5
5

l. s. d. far.			
135	42	09	00 : 4
20			
8	49		
	12		
5	88		
	4		
3	55		

l. s. d. far.

2708 : 05 : 09 : 3

135 : 08 : 05 : 3

2843 : 14 : 03 : 1

Increase the third Year.

So that he must receive at the third Year

2843 l. 14 s. 3 d. 1/2.

Quest. 3. What comes the Interest of 1920 l. 17 s. for 8 Years, reckoning Interest upon Interest at 6 l. per Cent.

l. s. l.			
1920	17	at 6	per Cent.
	6		
115	25	02	
	20		
5	02		
	12		
0	24		
	4		
96			

l. s.
1920 : 17 Principal.
115 : 05 Interest.

2036 : 02 Increase
first Year.

Compound-Interest.

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l. s. d.
2036 : 02 at 6 per Cent. 1 : 78 1/2

122'16 : 12

20

332

12

384

440

336

l. s. d.

2036 : 02 : 00 Principal.

122 : 03 : 03 1/4 Interest.

2158 : 05 : 03 1/4 Increase second Year.

l. s. d.

2158 : 05 : 03 1/4 Principal.

129'42 : 11 : 10 1/2

20

991

12

1102

4

0110

l. s. d.

2158 : 05 : 03 1/4 Principal.

129 : 09 : 11 Interest.

2287 : 15 : 02 1/4 Increase third Year.

N 3

2287

Compound-Interest.

l. s. d.
2287 : 15 : 02 $\frac{1}{4}$ At 6 per Cent.
6

137 | 26 : 11 : 04 $\frac{1}{2}$
20

531
12

Principal 396 : 02 : 00
Interest 4 : 03 : 00
2287 : 15 : 02 $\frac{1}{4}$ Prin.
137 : 05 : 03 $\frac{1}{4}$ Int.
306 : 02 : 00
2425 : 00 : 06 $\frac{1}{2}$
Increase 4th Year.

l. s. d.
2425 : 00 : 06 : $\frac{1}{2}$ at 6 per Cent.
6

145 | 50 : 03 : 03 : 0
20

1003

12

039

4

156

2425 : 00 : 06 : $\frac{1}{2}$ Principal.
145 : 10 : 00 : $\frac{1}{4}$ Interest.

2570 : 10 : 06 : $\frac{3}{4}$
Increase the 5th Year.

Compound-Interest.

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l. *s.* *d.* *l.* : *oi* : *40* : 2885
2570 : 10 : 06 : $\frac{1}{4}$ at 6 per Cent.

6

154 23 : 03 : 04 : $\frac{1}{2}$

20

4 63

12

7 60

4

2 40

l. *oi* : *s.* : *d.* : 2885

2570 : 10 : 06 : $\frac{1}{4}$ Principal.

154 : 04 : 07 : $\frac{1}{2}$ Interest.

2424 : 15 : 02 : $\frac{1}{4}$

Increase the 6th Year.

l. *s.* *d.* *l.* : *oi* : *40* : 2885
2724 : 15 : 02 : $\frac{1}{4}$ at 6 per Cent.

6

163 48 : 11 : 01 : $\frac{1}{2}$

20

9 71

12

8 53

4

2 14

l. *s.*

2724 : 15 : 2 : $\frac{1}{4}$ Principal.

163 : 09 : 8 : $\frac{1}{2}$ Interest.

2888 : 04 : 10 : $\frac{1}{4}$ Increase 7th Year.

l. s. d. l.
 2888 : 04 : 10 : $\frac{1}{4}$ at 6 per Cent.

173 | 29 : 09 : 04 : $\frac{1}{2}$

20

589

12

1072

4

290

l. s. d.
 2888 : 04 : 10 : $\frac{1}{4}$ Principal.
 173 : 05 : 10 : $\frac{1}{2}$ Interest.

3061 : 10 : 09 : $\frac{1}{4}$ Increase the 8th Year.

Thus you find that the Sum of 1920 l. 17 s. put out at Interest upon Interest at 6 l. per Cent. per Ann. for 8 Years, amounts to 3061 l. 10 s. 9 d. $\frac{1}{4}$. and how it amounts to each Year, you may see yearly from the working of the Question.

Thus much for Simple and Compound-Interest, till we come to Decimal Arithmetick.





C H A P. XVIII.

E X C H A N G E.

TH E whole Business of the Exchange of Coins from one Country to another, it is necessary that the *Par* or Value of the Money in each Place be exactly known, but the rising, falling, and debasing of the same, is so Subject unto Change, Examples whereof you see in *France*, and other Countries; so that of Necessity the Merchant by knowing daily upon the *Exchange*, how the Equality or *Par* of Coins riseth or falleth; you may by the *Rule of Three*, or the *Rule of Practice* work any Question, I shall therefore give you some Questions, and so leave you to enlarge as you shall find Occasion.

As for E X A M P L E.

A Merchant delivered 530 *l. Sterl.* in *London*, at 20 *s. per l.* to receive the same by a Bill of Exchange at *Amsterdam*, the Exchange at thirty-three Shillings and four Pence *Flemish*, for a Pound Sterling, I demand the same in *Flemish* Money.

N O T E, That in the stating of your Question, your first, and third Numbers must be both of one Kind; if the first be *Sterling* Money, the third must be

be Sterling; if the first be *Flemish*, the third must be *Flemish*.

Quest. 1. If 20 s. Sterling give 33 s. 4 d. what will 530 l. Sterling?

s.	l.	s.	l.
If 20	33	:	4
	12		20
	400		10600
			400
			4240000
			12
20	4240000	(2120000)	(1766 6
40		12	
			883 6 : 8
24	92		
20	84		
40	80		
40	72		
0	80		
	72		
	80		
	72		
	8		

Answer, *Flem.* 883 l. 6 s. 8 d.

Or

Exchange.

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Or thus shorter.

$$\begin{array}{r}
 \text{l.} \quad \text{s.} \quad \text{d.} \\
 3) 530 \text{ at } 33 : 4 \\
 \underline{33} \\
 1590 \\
 \underline{1590} \\
 17490 \\
 \underline{176 : 8} \\
 17668 : 8 \\
 \underline{88316 : 8} \\
 \underline{\quad}
 \end{array}$$

Quest. 2. If I deliver in *Antwerp* 7110 l. 16 s. *Flemish*, the Exchange at 27 s. 8 d. $\frac{1}{2}$ *Flemish* per 20 s. *Sterling*, what Money *Sterling* shall be received in *London*, when the Exchange is as above.

Thus by the Rule of Three Direct.

$\begin{array}{ccc} \text{s.} & \text{d.} & \text{l.} \end{array}$
 If 27 : 8 $\frac{1}{2}$ produce 20 *Sterl.* what 7110 : 16 *Flem.*
 And by the Work you will find it to make
 5132 l. 12 s. $+\frac{1}{2}\frac{2}{8}\frac{2}{8}$ received in *London*.

PROOF

PROOF

Exchange.

P R O O F.

By Conversion.

l. s. d. s. d.
 $\frac{2}{3}$) 5132—12—1 at 27—8 $\frac{1}{2}$ Flem.
 27 : 0021

35924 — 8 d. $\frac{2}{3}$ s.
 10264 0047 $\frac{1}{2}$ $\frac{1}{2}$ of 4 d.

10 s. $\frac{1}{2}$

Price

2 s. $\frac{3}{10}$: 10 s.

1 d. 12 : 1 s.

138564

1710—08

8) 1710—08

213—10

13—10 $\frac{1}{2}$ 1—04 $\frac{1}{2}$ 1—04 $\frac{1}{2}$ 0—01 $\frac{1}{4}$ 3 $\frac{1}{2}$ = $\frac{1}{4}$

Mites

4221 15—10— $\frac{1}{4}$ 3 $\frac{1}{2}$ 7110 15—10— $\frac{1}{4}$ 3 $\frac{1}{2}$

Quest. 3. At what Rate went the Exchange from
 London to Rotterdam, when I deliver 700 Pounds Ster-
 ling in London, and receive in Rotterdam 1010 Flem.

l.

l.

s.

If 700 Sterl. make 1010 Flem. what 20 Sterl.

l. s. d.

Facit per Rule of Three 1 : 8 : 10 : $\frac{1}{4}$.

PROOF.

Exchange.

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PROOF.

l. l. s. : d.
700 at 01 : 08 : 10 $\frac{1}{4}$

I

		(Sterl.)
$\frac{1}{2}$)	700 : 00 : 00 : 00	8 s. $\frac{2}{3}$ of a Pound
	140 : 00 : 00 : 00	6 d. $\frac{1}{8}$ of 4 s.
8)	140 : 00 : 00 : 00	3 d. $\frac{1}{2}$ of 6 d.
8)	17 : 00 : 00 : 00	1 d. $\frac{1}{2}$ $\frac{1}{2}$ of 3 d.
2)	8 : 15 : 00 : 00	$\frac{1}{4}$ $\frac{1}{6}$ of 1 d. $\frac{1}{2}$
	4 : 07 : 06 : 00	
	0 : 14 : 07 : 00	

1011 : 07 : 01 : 00 Small Diff.

Quest. 4. How many Dollars at 4 s. 4 d. per Piece shall I give for 9010 Sterling in Flanders?

Therefore,

If 4 : 4 Sterl. make 1 Dollar, what will 9010 Sterl.

12

20

52

180200

2162400

52)

Exchange

52) 2162400 (41584 Dollars $\frac{1}{2}$.

208

82

52

304

260

440

416

240

208

32

Answer, 41584 Dollars $\frac{1}{2}$ at 4 s. 4 d. must be delivered in Flanders for 9010 l. Sterling.

Quest. 5. How much Sterling must I pay here in London to receive in Hamburgh 836 l. 8 s. 4 d. Flemish, Exchange at 36 s. 8 d. Flem. per 20 s. Sterling?

Thus,

If 36 : 8 — make 20 Sterl. — 836 : 8 : 4

Reduced.

Pence

Pence

Pence

440

240

200736

440

Product is 48176640

Exchange.

191

$$\begin{array}{r}
 12 \\
 440)48176640(109492(912|4 \\
 \underline{440} \dots\dots 108 \dots\dots \\
 4176 \qquad 14 \\
 \underline{3960} \qquad 12 \\
 2166 \qquad 29 \\
 \underline{1760} \qquad 24 \\
 4064 \qquad 52 \\
 \underline{3960} \qquad 48 \\
 1040 \qquad 4 \\
 \underline{880} \\
 160
 \end{array}$$

Answer, 456 l. 4 s. 4 d. $\frac{4}{11}$ he must deliver in London.

Quest. 6. If 35 Ells at *Vienna* make 24 Ells at *Lyons*, 3 Ells of *Lyons* 5 Ells of *Antwerp*, and 100 Ells of *Antwerp* 125 Ells at *Franckfort*, how many Ells of *Vienna* are equal unto 50 Ells at *Franckfort*?

Answer, 35.

Suppositions 35 A = 24 B.
 3 B = 5 C.
 100 C = 125 D.
 50 D = A.

$$\begin{array}{r|l}
 35 & 24 \\
 3 & 5 \\
 100 & 125 \\
 50 & \\
 \hline
 525000 &)15000 \\
 \hline
 \end{array}$$

The Rule, Multiply all the given Terms, which stand in the first Column, by continual Multiplication, and let that be your Dividend.

15000

15000)525000(35

45000

75000

75000

00

Answer 35 Ells of
Vienna as was
required.

35

3

105

100

10500

50

525000 Dividend.

Divisor.

15000

24

5

120

125

600

240

120

Quest. 7 If 16 l. of *Avoirdupois* Weight at *London* be equal to 9 lb. of *Amsterdam*, 45 of *Amsterdam* 49 lb. at *Bruges*, and 98 lb. at *Bruges*, equal to 116 lb. at *Dantzick*; how many Pound of *Dantzick*, are equal to 112 lb. of *Avoirdupois* Weight at *London*.

Soppositions { 10 A. = 9 B. 10 | 9
45 B. = 49 C. 45 | 49
98 C. = 116 D. 98 | 116
Quest. 112 A. = D. | 112
Answer, 129 lb. $1\frac{2}{3}$ Dantzick.

The RULE.

Multiply all the given Terms which stand in the latter Column, and the last odd Term in the first Place by continual Multiplication, and make it your Dividend.

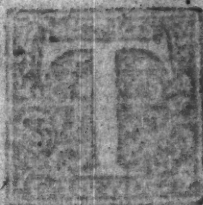
Again,

Exchange.

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Again, multiply continually the rest of the Terms which stand in the first Column, and make it your Divisor, so the Quotient is your Answer.

10	9
<u>45</u>	<u>49</u>
50	441
<u>40</u>	<u>116</u>
450	2646
98	441
3600	441
<u>4050</u>	<u>51156</u>
	112
44100 Divisor.	102312



O C H A P.

Repeating

C H A P. XIX.

Alligation-medial.

1. **T**H E Rule of *Alligation* is that by which we resolve Questions, that concern the mixing of divers Simples together.

2. *Alligation* is either *Medial* or *Alternate*.

3. *Alligation Medial* is, when having the several Quantities and Rates of divers Commodities propounded, we discover the mean Rate of a Mixture compounded of those Commodities.

Quest. 1. So 5 Bushels of Wheat at 2 s. 8 d. a Bushel, 9 Bushels of Rye at 2 s. per Bushel, I would know how much the Bushel so mixed would stand him in, the one with the other?

The Operation.

To work this Rule, multiply every Commodity by his Price, and add all the Products together, and make it your Dividend: Then add up all the Quantities together which your Mixture was composed of, and that Product make your Divisor, and the Quotient is your Answer to the mean Rate or Price of that Part.

Repeating

Repeating again the abovefaid Example, I demand how much that Miftling is worth?

Thus according to Rule.

s.	d.	s.	d.	s.	d.
2	: 8	2		13	: 4
5		9		18	: 0 add.
13	: 4	18		31	: 4
		5 Bushels of Wheat.		376	Dividend
		9 Bushels of Rye.			
		— add			
		14 Divisor.			
		—			

Then 376 divide by 14. Answer, 2 s. 2 d. $\frac{1}{4}$.

12 s. d.
 14)376(26(2 : 2 + $\frac{1}{4}$ or $\frac{5}{4}$; so that I conclude
 28 24 that a Bushel of that Mift-
 ———— ling may be afforded for
 96 2 2 s. 2 d. $\frac{5}{4}$, or $\frac{1}{3}$ farth. is the
 84 — Resolution of the Question
 ———— propounded.
 12

The P R O O F.

In *Alligation-medial* the Trial of the Work is by comparing the total Value of the several Simples, with the Value of the whole Mixture; and when those Sums agree, the Operation is perfect, so in this Example.

O 2

5 Bushels

$s. : d.$
 5 Bushels of Wheat at 2 s. 8 d. is — 13 : 4 } add.
 9 Bushels of Rye at 2 s. — — 18 : 0 }

All which amount unto — 31 : 4

which is likewise the Value of 14 Bushels of Wheat
 at 2 s. 2 d. + $\frac{2}{3}$.

bbs 0 : 81

For by the Rule of Three.

If 1 Bushel cost 2 s. 2 d. + $\frac{2}{3}$, what will 14 Bushels.

Answer, 31 s. 4 d. with the Fraction $\frac{2}{3}$, or $\frac{2}{3}$ farth.

Quest. 2. A Grocer hath 27 lb. Weight of large
 Cloves, at 6 s. per lb. 15 lb. of the middle Sort at
 2 s. 6 d. per lb. and 10 lb. of worser Sort at 2 s. 2 d.
 mix these together, and how shall I sell it then by
 the Pound.

lb.	s.	d.	lb.	s.	d.	lb.	s.	d.
27	at 6 p.	lb.	15	at 2 : 6 p.	lb.	10	at 2 : 2 p.	lb.
6			2			2		
16	2		30			20		
8	2		7 : 6			1 : 8		
			3 : 7	6		2 : 1	8	
			17 : 6			1 : 1	8	

Add

Alligation-medial.

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l. s. d.

Add 8 : 2 : 0

1:17:6

— 1 : 1 : 8

Facit 11 : 1 : 2

20

Shill. 221

12

Pence 2654 Dividend

$$52(2654)51(4)3+\frac{1}{2}6.$$

260. 48

54 37

52 —

Answer: 8 or 14 out of 20

Answer, He must sell the Cloves so mixt,
for 4 s. 3 d. $\frac{2}{3}$ per lb.

Quest 3. A Goldsmith hath 8 lb. Weight of Silver Bullion of 7 oz. fine, 15 lb. of 8 oz. $\frac{1}{2}$ fine, and 13 lb. of 10 Ounces fine, and he would melt all together, and know what Fineness a Pound Weight of that Mass would come to?

15. 02.

8 of 7

7

56

15. 02

15 of 8

8

120

 $7 : \frac{1}{2}$

BU301

O 3

16. 02.

13 of 10

10

—

Add

Add	8
56	13
127 $\frac{3}{4}$	13
130	13
313 $\frac{1}{2}$	36
2	2
627 Dividend	Divisor 72

oz. pur. gr.

72)627(8 $\frac{1}{2}$ or $\frac{13}{14}$ makes 14 : 4

576

51

Answer, 8 oz. 14 pur 4 grains the Mals must be.

Quest. 4. A Merchant having several Sorts of Cloth is desired to fix a Price, how to sell one Ell with another, now what Price ought he to set upon the following Parcels, that he may neither lose nor gain above the Prices?

Ells	s.	d.	s.	d.
30 at 5 : 0	per Ell is	150	:	0
35 at 7 : 6	per Ell is	262	:	8
40 at 9 : 0	per Ell is	360	:	0
60 at 12 : 6	per Ell is	750	:	0
add.				

Then if 165 Ells give 1522 : 6 what 1 Ell

12

Dividend 18270 Pence.

Ells

Ells

30
35
40
60

165 Divisor 165)18270(110 9 : 2 + $\frac{1}{4}$ very
165 108 (near.

177
165

Answer 72 2 4 1

Quest. 6. An Hollander Provender for Horses

120 24
165 33 = $\frac{1}{4}$ fere.

Answer he must sell it for 9 s. 2 d. 4 $\frac{1}{4}$.

Quest. 5. A Vintner having 24 Gallons of Canary at 8 s. per Gallon, 16 Gallons of Claret at 4 s. per Gallon, 42 Gallons of Rhenish Wine at 6 s. per Gallon, and 12 Gallons of Palm-Wine at 16 s. per Gallon, how may he sell these together that he may not lose?

Gallons. Shill.

24 at 8 is 192
16 at 4 is 64
42 at 6 is 252
12 at 16 is 192

If 94 Gallons. 700 Shill. what 1 Gallon.
Divisor 12

8400 Dividend.

$$94)8400(89(7 : 5 \frac{1}{2}$$

$$752 \cdot 84$$

$$880 \cdot 5$$

$$846$$

$$34$$

Answer, 7 s. 5 d. $\frac{1}{2}$.

Quest. 6. An Hostler mixed Provender for Horses,
viz.

5 Bushels of Oats 3 : 6 per Bushel, is 17 : 6

3 Bushels of Oats 4 : 8 per Bushel, is 14 : 0

2 Bushels of Malt 2 : 2 per Bushel, is 4 : 4

4 Bushels of Beans 5 : 3 per Bushel, is 21 : 0

14 Bushels

4

56 Pecks

56 : 10

12

Pence 682

If 56 Pecks give 682 Pence, what will 1 Peck.

$$56)682(12 + \frac{1}{2} \text{ or } 12\frac{1}{2} \text{ of a Penny.}$$

$$56 \cdot$$

$$122$$

$$112$$

$$10$$

He must sell it for 12 d $\frac{1}{2}$ a Peck.

C H A P.

CHAP. XX.

Alligation-alternate.

DEFINITION.



Alligation-alternate is, when having the several Rates of divers Simples given, we discover such Quantities of them, as are necessary to make a Mixture, which may bear a certain Rate propounded.

The right ordering of the Terms.

First you must set down the Numbers of which you will make the *Alligation*, orderly one under the other: and the common Number, whereinto you must reduce them, set on the Left-hand. Then Note, which of the said Numbers are lesser than that common Number, and which of them be greater, and with a Draught of your Pen link two Numbers together; so that the least Number may be still linked with the greatest, and the greatest with the smallest.

Then add up all these Differences into one Total, which shall be the first Number in the *Rule of Three*, and the second Number the common Number, then the Third must be each Difference done by itself.

As

As for EXAMPLE.

Quest. 1. A Man being determined to mix Wheat at 28 *d.* per Bushel, Rye at 20 *d.* Barley at 14 *d.* and Oats at 10 *d.* per Bushel, are to be mixed, as a Bushel of the Mixture may be sold for 16 *d.* Therefore drawing a Line of Connexion, I place

28	6	Wheat.
20	2	Rye.
14	4	Barly.
10	12	Oates
	24	



Having ranked the Terms in their due order in such Sort, that one, that is greater than the Root or Order of the Mixture, may always be coupled with another that is Less than the same; the whole Fabrick of the Work, as the Branches are thus linked, will stand as in this Example.

Then according to Rule.

Busb. *Busb.* *Busb.*
1st If 6 of Wheat give 2 of Rye, what 10 of Wheat.

Busb. *Busb.* *Busb.*
2d, If 6 of Wheat give 4 of Barley, what 10 of Wheat.

Busb. *Busb.* *Busb.*
3. If 6 of Wheat give 12 of Oats, what 10 of Wheat.

Facit 20.

Quest. 2.

Quest. 2. A Vintner hath 4 Sorts of Low-Wine of four several Prices, the first at 8 *d.* per Gallon, the second at 10 *d.* per Gallon, the third at 15 *d.* per Gallon, and the 4th at 18 *d.* per Gallon: Now he would mix all these Sorts together, that a Gallon of these (lower or decayed) Wines may be worth 12 *d.* the Puncheon holding 84 Gallons.

Then



Gall.
If 15 ——— 84 ——— 6

Facit 33 + $\frac{1}{3}$ of the first Sort.

Gall.
If 15 ——— 84 ——— 3

Facit 16 + $\frac{4}{5}$ of the 2d Sort.

Gall.

If 15 give ——— 84 ——— what will 2

Facit 11 + $\frac{1}{3}$ of the 3d Sort he must take.

Gall.

If 15 give ——— 84 ——— what will 4

Facit 22 + $\frac{2}{3}$ of the 4th Sort.

Which said Quantities added up make 84, viz.

33

Fractions

16

$\frac{1}{3}$

5

10 (2 for Fractions.

11

$\frac{1}{3}$

22

$\frac{2}{3}$

2 add.

1

84 for Proof. *facit.*

Quest. 3.

Quest. 31 A Goldsmith hath Divers Sorts of Gold, viz. some of 24 Carrets, others of 22 Carrets, others of 18 Carrets, and others of 16 Carrets fine, is desirous to melt as much of all these four Sorts together, as may make a Mass of Gold to contain 60 Ounces of 21 Carrets fine.

Then

24 22 18 16	5 3 1 3 12	If 12 ——— 60 ——— 5 Facit 25 Ounces of the 1st. If 12 ——— 60 ——— 3 Facit 15 Ounces of the 2d. If 12 ——— 60 ——— 1 Facit 5 Ounces of the 3d. If 12 ——— 60 ——— 3 Facit 15 Ounces of the 4th.
----------------------	------------------------------	---

Which said Quantities so taken and mix'd, make up the Mass of 60 Ounces of 21 Carrets fine.

Viz

25 Ounces of the first Sort.
 15 Ounces of the second.
 5 Ounces of the third.
 15 Ounces of the fourth.

60 Ounces of 21 Carrets fine.

Quest. 4

Quest. 4. A Refiner hath some Gold of 24 Carrects fine, other of 21 Carrects fine, and others of 19 Carrects, which he would so mix, that 192 Ounces of the intire Mixture might bear 17 Carrects fine. Now the Question is, how much of each sort, as also how much Alloy he must take to accomplish his Desire.

Note, Before you can well understand this Question, it will be very necessary to know what you mean by a Carrect fine, and what Alloy is: The Refiners and Goldsmiths, to distinguish the different Fineness of Gold, esteem an intire Ounce to contain 24 Carrects, and one Ounce of Gold that being tried in the Fire by losing nothing of the Weight, is esteemed by the Mint-Masters to be 24 Carrects; but if after being tried, loseth one four and twentieth Part of the Weight, is said to be 23 Carrects fine: In like Manner, that which loseth two four and twentieth Parts of the Ounce is esteemed to be 22 Carrects fine, and so consequently of the rest.

And as for what they call Alloy, it is Silver, Copper, or some other baser Metal, with which the Refiners use to mix their Gold, to the Intent they may make or abate the Fineness thereof.

Here you must also take Notice, That as the Fineness of Gold is measured by Carrects, so is the Fineness of Silver estimated by Ounces; in such Sort, that a Pound of Silver, which being tried a certain Time in the Fire, and by losing nothing of the Weight, is said to be 12 Ounces Fine: But a Pound that being tried loseth somewhat of the Weight, is said to be the Remainder of the Weight fine: As for Example, A Pound of Silver, that loseth in the Fire one Ounce, 8 Pennyweight, is estimated to be 10 Ounces, 12 Penny-weight fine, and that which loseth two Ounces, 8 Pennyweight, 10 Grains, is said to be 9 Ounces, 11 Pennyweight, 14 Grains fine, &c. Now

Now to rank the Terms of this last mentioned Question, as also the Differences of the Terms in their due order; because the three given Branches (*viz.* 24 Carrets, 21 Carrets, and 19 Carrets are all greater than 17 Carrets the Root, or Rate of the Mixture; I therefore add 0 as another Branch, which is less than the Root, then the whole frame of the Work will stand as followeth;

$$\begin{array}{r}
 \begin{array}{l} 24 \\ 21 \\ 19 \\ 0 \end{array} \left\{ \begin{array}{l} 17 \\ 17 \\ 17 \\ 17 \end{array} \right. \\
 \hline
 0 \quad 7 \cdot 4 \cdot 2 = 13
 \end{array}$$

$$\begin{array}{r}
 \begin{array}{l} 24 \\ 21 \\ 19 \\ 0 \end{array} \left\{ \begin{array}{l} 17 \\ 17 \\ 17 \\ 17 \end{array} \right. \\
 \hline
 0 \quad 7 \cdot 4 \cdot 2 = 13
 \end{array}$$

Then if,

$$\begin{array}{cccccc}
 \text{oz.} & & \text{oz.} & & \text{oz.} & & \text{oz.} & & \text{oz.} & & \text{oz.} \\
 64 & \text{---} & 192 & \text{---} & 17 & & 64 & \text{---} & 192 & \text{---} & 17
 \end{array}$$

Facit 51 Ounces.

Facit 51 Ounces.

$$\begin{array}{cccccc}
 \text{oz.} & & \text{oz.} & & \text{oz.} & & \text{oz.} \\
 64 & \text{---} & 192 & \text{---} & 17 & & \text{If } 64 & \text{---} & 192 & \text{---} & \text{what will } 13
 \end{array}$$

Facit 51 Ounces

Facit 39 Ounces.

So that you must mix 51 Ounces of every Sort with 39 Ounces, and it will make 192 Ounces fine.

For

For,

oz.

51

51

51

39

Facit 192 Ounces.

And therefore for Conclusion, I say, that 51 Ounces of Gold, 24 Carrets fine, 51 Ounces of 21 Carrets fine, 51 Ounces of 19 Carrets fine, and 39 Ounces of Alloy being all mixed together will produce a Mass of 192 Ounces of Gold, of 17 Carrets fine, which is the Satisfaction of the Question premised.



Question. To resolve this. I would know how much A. ought to pay. That B. is to pay double what A. must pay, and C. them 1000. was. A. B. and C. and they so agree. Quest. Three men bought a ship. (which cost

C H A P. XXI.

The Rule of False or Single Position.

DEFINITION.

THIS Rule is called the *Rule of False*, or *Rule of Position*, because any Number is taken for to work the Question by, and placed instead of the Number sought after the Position, wherefore you Question according to the Tenor thereof; and if your Position happen to be true, then you have satisfied the Question: But if you have taken your Position false (from whence it is called the *Rule of False Position*) then the true Number is found out by this Rule, of which there are two Kinds, First, the *Single Rule*, Secondly, the *Double Rule*.

The *Rule of single Position* is to be used, when at once, viz. by one false Position we have Means to discover the true Resolution of the Question propounded.

As for EXAMPLE.

Quest. 1. Three Men build a Ship (which cost them 2700 l.) viz. A, B, and C, and they so agree, that B. is to pay double what A. must pay, and C. tripple to that which B. payeth, I would know how much every Man ought to pay. To resolve this Question,

Single Position.

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Question, I suppose *A.* paid 6*l.* therefore *B.* paid 12*l.* and *C.* must pay 36*l.* But by this Position of 6*l.*+12*l.*+36*l.* added, maketh 54*l.* which by the intent of the Question ought to have been 2700*l.* Nevertheless, by those supposititious Numbers, I shall discover the true Sums which the several Parties ought to pay; for I say by the *Rule of Three Direct*:

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 1. \text{ As } 54 \text{ is to } \text{---} 6 \text{---} \text{what will } 2700 \\ \hline \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad 6 \end{array}$$

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 54)16200(300 \text{ } A. \text{ must pay } \text{---} \\ \underline{162} \text{ } 00 \\ \text{---} \end{array}$$

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 2. \text{ As } 54 \text{ is to } \text{---} 12 \text{---} \text{what will } 2700 \\ \hline \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad 12 \end{array}$$

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 54)32400(600 \text{ } B. \text{ must pay. } \text{---} \\ \underline{324} \text{ } 00 \\ \text{---} \end{array}$$

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 3. \text{ As } 54 \text{ is to } \text{---} 36 \text{---} \text{what will } 2700 \\ \hline \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad 36 \end{array}$$

$$\begin{array}{r} \text{l.} \qquad \qquad \qquad \text{l.} \qquad \qquad \qquad \text{l.} \\ 54)97200(1800 \text{ } C. \text{ must pay. } \text{---} \\ \underline{54} \text{ } 00 \\ \text{---} \\ 432 \text{ } 00 \\ \underline{432} \text{ } 00 \\ \text{---} \end{array}$$

000

For PROOF.

A. pays 300

B. pays 600

C. pays 1800

 Total is 2700 the Sum propounded

Quest. 2. A Gentleman having about him a certain Number of Crowns, said if a Fourth, a Third, and a Sixth of them, were added to what he had about him they would make 45 Crowns, what were the Number of Crowns he had about him?

Answer 60 Crowns.

I suppose he had 24 Crowns then.

Crowns

 $\frac{1}{4}$ of 24 is 6 $\frac{1}{3}$ of 24 is 8 $\frac{1}{6}$ of 24 is 4

 All which make 18

But if 18 come of 24 what will 45 Crowns.

PROOF.

Crowns

 $\frac{1}{4}$ of 60 is 15 $\frac{1}{3}$ of 60 is 20 $\frac{1}{6}$ of 60 is 10

180

90

18) 1080 (60 Crowns.

108

Facit 45 Crowns:

00

Quest.

Single Position.

211

Quest. 3. A Traveller found, $\frac{1}{2}$ more, $\frac{1}{3}$ more, $\frac{1}{4}$ more, would have made it 50 l. what did he find?

Answer, 46 l. $\frac{2}{3}$.

I suppose he found 12 l.

Then the

$\frac{1}{2}$ of 12 is 6
 $\frac{1}{3}$ of 12 is 4
 $\frac{1}{4}$ of 12 is 3

If 13 l. come of 12 l. what will 50 l. be?

13)600(46 $\frac{2}{3}$
 520
 80
 78
 2

P R O O F.

$\frac{1}{2}$ of 46 is 23
 $\frac{1}{3}$ of 46 is 15 $\frac{2}{3}$
 $\frac{1}{4}$ of 46 is 11 $\frac{3}{4}$
 add 1

1 Fraction.

Total 50

Single Position.

Quest. 4. A Gentleman going over a Common, asked a Shepherd how many Sheep he had? Answer'd, if I had as many more as I have, and $\frac{1}{2}$ so many more, $\frac{1}{3}$ more, $\frac{1}{4}$ more, and 1 more, I should have 112 Sheep, the Question is how many had he?

Answer, 36 Sheep.

Suppose 24 Sheep.

Then the Number is 24

The $\frac{1}{2}$ is — 12

The $\frac{1}{3}$ is — 8

The $\frac{1}{4}$ is — 6

1

75

If 75 ————— 24 ————— 112

24

75)2688(35 + $\frac{61}{75}$ fere.

225

438

375

63

448

224

2688

36

36

18

12

9

1

112 Sheep.

Quest. 5.

Single Position.

213

Quest. 5. One said he knew not what Money he had in his Purse, but he knew that the third Part, and the fourth Part, and the fifth Part thereof would make 94 Pounds, what Money had he?

Suppose 60 l. Answer, 120 l.

The $\frac{1}{3}$ Part is 20
 $\frac{1}{4}$ Part is 15
 $\frac{1}{5}$ Part is 12

47 come of — 60 — 94
 60

47)5640(120

PROOF.

For $\frac{1}{3}$ Part is 40
 $\frac{1}{4}$ Part is 30
 $\frac{1}{5}$ Part is 24

94

P 3

Quest. 6

Quest. 6. I have delivered to a Banker a certain Sum of Money to have of him by the Year 6 $\frac{1}{2}$ for every 100 l . and at the End of 10 Years he paid me 500 Pounds for all, both Principal and Interest, what was the Principal Sum I delivered him at first?

Suppose 100 Pounds.

Months	Years
Then if 12	10
be 6	12
12) 720 (60	Simple-Interest.
72	120
00	6
00	720

Then if 160 — be 100 what will 500

160) 50000 (312 : 10 is the Sum
48000 delivered at first.

200
160

400
320

80

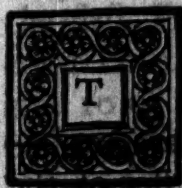
Thus much for Single Position.

The next in Order is the Double Rule of False or Double Position.

C H A P. XXII.

Double Position.

DEFINITION.



THE Rule of Double Position (or Double Rule of False,) is when two false Positions are supposed, for the Resolution of the Question propounded.

The Operation.

In this Rule, having drawn two Lines a-cross, and placed the Terms of the False Position (*viz.* those that have the same Denomination) at the uppermost End of that Cross, as also each Error under his respective Position, at the lower End of the same Cross, multiply each Error by its contrary Position; that is the second Error by the first Position, and the first Error by the second Position. This done, when both the Errors are of one and the same Kind, (*viz.* both Excesses, or both Defects) subtract the less Product out of the greater, and then the Remainder is your Dividend; but if the Errors be of differing Kinds (*viz.* one of them an Excess, and the other a Defect,) add those Products together, and then that Sum will be your Dividend, which if you divide by the Difference of their Errors, (when

they are of one and the same Kind) or by their Sum (when they are of different Kinds) the Quotient will give you the Number you look for, having the same Denomination with the false Positions placed at the upper End of the Cross; a few Examples will demonstrate this Rule to be plain and easy.

Quest. 1. A Workman having threshed out 40 Quarters of Grain, (Part thereof being Wheat, and the rest Barley, received for his Labour 28 s. being paid after the Rate of 12 d. for every Quarter of Wheat, and 8 d. for each Quarter of Barley: Now I would know how many of those 40 Quarters were Wheat, and how many Barley.

$$\begin{array}{r}
 26 \quad 32 \quad 150 \\
 \text{X} \\
 5 \quad \quad 7 \\
 \hline
 \quad 2 \quad \quad
 \end{array}
 \quad (16)$$

Note, That this Character — signifies that the Lesser of the two Numbers, betwixt which it is found, ought to be subtracted from the greater.

This done, having multiplied 26 by 7, the Product is 182, and likewise 30 by 5 the Product is 150; which being subtracted out of 182 (because the Errors here are both of the same kind; that is, are each of them an Excess above 28 s. the Sum that the Workman received,) the Remainder is 32, which being divided by 2, (the Difference betwixt 5 and 7,) leaves in the Quotient 16 for the Quarters of Wheat that the Workman threshed, whose Complement to 40, viz. 24 are the Quarters of Barley that he threshed: Thus I say, the Workman having received 28 s. for his threshing out 40 Quarters of Grain, (being Part Wheat, Part Barley, at 12 d. the Quarter of Wheat, and

and 6d. the Quarter of Barley; threshed in all 16 Quarters of Wheat, and 24 Quarters of Barley.

In this first Operation as you may find by the Work itself, that there was at first proposed at a Venture 26 Quarters of Wheat, and 14 of Barley; and then to discover whether I have guessed Right or Wrong, I find how much Money is due unto the Workman, at the Rate of 12 d. the Quarter of Wheat, and 6 d. of Barley, which I find to be 33 s. viz. 26 s. for the 26 Quarters of Wheat, and 7 s. for the 14 Quarters of Barley) which he ought to have received if my Supposition had been right; but because of the Difference betwixt 28 s. and 33 s. I keep in Mind 5, their Difference, which is called the first Error: Therefore I propound for the second Position, that there was 30 Quarters of Wheat, and 10 of Barley; and then the second Error I find to be 7, for there is then due to the Workman for the 30 Quarters of Wheat 30 s. and for the 10 Quarters of Barley 5 s. in all 35 s. which differs from 28 s. the true Sum that he received by 7 s. so that you may perceive by the Operation, as in the Rule directed, how all Questions, when the Positions are both Excesses may be performed.

Therefore for the better understanding of the Rule before premised, I will set down the same Question under other Suppositions.

Quest. 2. I suppose therefore for the second Time 10 Quarters of Wheat, and 30 Quarters of Barley, and then proceeding as before, the first Error will prove 3 s. which upon that Position I want of 28 s. the right Sum?

Again, for the second Position I take 26 Quarters of Wheat, and 14 of Barley, and then the second Error will be 5 s. too much of the true Sum of 28 s. Therefore the first being a Defect of 3 s. and my last Position

Position 5 is too much; I therefore work by my Rule, when the Positions are one of them an Excess, and the other a Defect, as per the Operation you may observe.

$$\begin{array}{r} 50 + 78 \\ 10 \quad 128 \quad 26 \end{array}$$

X

(16)

+

$$\begin{array}{r} 3 \quad 8 \quad 5 \end{array}$$

Note, That this Character **X** intimates, that the Numbers betwixt which it is found, ought to be added together.

EXPLANATION.

Now multiplying 10 by 5 the Product is 50, and 26 by 3 the Product is 78; and here (because the Errors are of different Kinds, one of them being an Excess, and the other a Defect of 28, the true Sum) you then are to add 50 and 78, the two Products together, whose Sum is 128, which being divided by 8, the Sum of the two Errors 3 and 5 gives you in the Quotient 16, for the Quarters of Wheat, as before in the former Resolutions; so that what Positions soever you take in this Question, you shall always find, that the Workman threshed 16 Quarters of Wheat, and 24 of Barley, as before propounded. And because you may not forget your Rule, take this short Remembrance.

Unlike require Addition,

And like desire Subtraction,

Quest. 3. A certain Man being demanded what was the Age of his four Sons? *Answer'd,* That his eldest Son was four Years elder than the second, his second Son was four Years elder than the third, his third Son was four Years elder than the fourth or youngest

Double Position.

219

youngest, and his fourth or youngest was half the Age of the eldest: The Question is to know what was the Age of each Son?

First, suppose the Age of the eldest 16, then by the Question the Second must be 12, the third 8, and the fourth or youngest 4: But it ought to have been 8; so that it wants 4 of what it ought to be.

I therefore make a second Supposition, and take 20 for the Age of the eldest Son, then the Age of the second will be 16, the Age of the third 12, and the Age of the fourth or youngest 8, which should have been half 20, so that it wants 2 of what it ought to have been; so that in both these Suppositions there are Defects, and by Consequence a like

The Scheme followeth:-

$$\begin{array}{r} 16 \quad 48 \quad 20 \\ \times \\ \hline 4 \quad 2 \end{array}$$

(24

Both Defects, work accordingly as per Rule.

$$\begin{array}{r} 4 \quad 2 \\ \times \\ \hline 2 \end{array}$$

$$\begin{array}{r} 16 \quad 20 \\ \times \\ \hline 2 \end{array}$$

$$\begin{array}{r} 32 \\ \times \\ \hline 32 \end{array}$$

$$\begin{array}{r} 80 \\ \times \\ \hline 32 \end{array}$$

add

48 Dividend.

$$\begin{array}{r} 48 \\ \times \\ \hline 2 \end{array}$$

2 Divisor

2)48(24 Years of Age the eldest.

There-

Double Position

Therefore the Age of the Eldest is,

24 eldest Son.

20 second Son.

16 third Son.

12 youngest Son.

Which answers the Question, for 12 the youngest Son is half the Age of the eldest, viz. 24.

Quest. 4. Three Men, A, B, and C, built a House which cost 76 l. of which A. paid a certain Sum unknown, B. paid as much as A. and 10 over, and C. paid as much as A. and B. now I desire to know each Man's Share in this Building?

6 168 9

X

14 for Answer.

32 12 20

X

First, I suppose A. paid 6 l.

2dly, I suppose A. paid 9 l.

A. pays 6

B. — 16

C. — 22

} by the Question.

In all 44 Pounds,

76

44

32

Which should have been 76 l. therefore if I take 44 l. from 76 l. there is 32 Pounds too little.

Again,

Double Position.

221

Again, I suppose $\left\{ \begin{array}{l} A. \text{---} 9 \\ B. \text{---} 19 \\ C. \text{---} 28 \end{array} \right.$
56 Pounds

But this 56 *l.* should have been 76 *l.* 76
 therefore too little by 20, so working ac- 56
 cording to the Rule you find 168 your Di-
 vidend, and 12 the Divisor. 20

Proof.

12)168(14 *l.* *A.* paid

12

48

48

0

A. paid 14

B. paid 24

C. paid 38

In all 76

As by the Question.

Quest. 5. Let it be required to divide 100 *l.* amongst 3 Persons, viz. *A.*, *B.*, *C.* in such a Manner that the Share of *B.* may be the triple of the Share of *A.*, and 4 Pounds over and above; also, that the Share of *C.* may be equal to the Sum of the Shares of *A.* and *B.*, and six Pounds over and above.

T H U S,

Let the first Position for the Share of *A.* be 12 Pounds, then *B.* must have 40 Pounds, and *C.* 58 Pounds: But 12 *l.* 40 *l.* and 58 is 110 Pounds, which is 10 Pounds too much.

110

(Then

Double Position.

Then for a second Position, I suppose for the Share of A, 8 Pounds, then B. must have 28 Pounds, and C. 42 Pounds, but $8 + 28 + 42 = 78$ l. But this 78 Pounds is too little by 22 l. for if I subtract 78 from 100, there will remain 22, which is too little; therefore this Question by the Suppositions, proves one too little by 22, and the other Supposition 10 Pounds too much.

$$\begin{array}{r} 264 + 80 \\ 12 \quad 34 \quad 8 \end{array}$$

X10 l. $+ \frac{1}{4}$ A. or 10 l. 15 s.

$$\begin{array}{r} 10 + 22 \\ 32 \end{array}$$

Proof.

l. o s.

A. — 10 — 15

B. — 36 — 5

C. — 53 — 0

100 — 0 Total

In all 100 l. according to the Question.

Quest. 6. A Gentleman riding over a Green, asked a Shepherd what was the Price of his hundred Sheep? Quoth he, Sir, I have not so many, but if I had as many more, and half so many more, and $7\frac{1}{2}$ Sheep, I should then have a Hundred, I demand how many Sheep he had?

Answer 37 Sheep.

Thus

Double Position.

223

Thus,

First, suppose 9
then 9

$$\begin{array}{r} 100 \\ 30 \\ \hline 70 \end{array}$$

$$\begin{array}{r} 30 \\ 7 \frac{1}{2} \\ \hline 37 \frac{1}{2} \end{array}$$

Secondly, suppose 11
then 11

$$\begin{array}{r} 11 \\ 5 \frac{1}{2} \\ \hline 16 \frac{1}{2} \end{array}$$

$$\begin{array}{r} 100 \\ 35 \\ \hline 65 \end{array}$$

Then this first Supposition is too little by 70.

And this second Supposition is too little by 65.

$$\begin{array}{r} 65 \\ 9 \\ \hline 585 \end{array}$$

$$\begin{array}{r} 585 \quad 770 \\ 9 \quad 185 \quad 11 \\ \hline X \quad (37 \\ 70 \quad 65 \\ 5 \end{array}$$

$$\begin{array}{r} 70 \\ 11 \\ \hline 770 \end{array}$$

Proof.

He had then 37 Sheep; for if you divide 185 by 5, the Quotient will be 37.

$$\begin{array}{r} 37 \\ 37 \\ \hline 138 \frac{1}{2} \\ 7 \frac{1}{2} \\ \hline 146 \end{array}$$

100 Sheep!

Quest. 7. Three Gamesters having gained 5 l. or 100 s. agree to divide it amongst them thus, viz. A, B, and C. B. shall have more Shillings than A. by 3, and C. shall have 4 Shillings more than B, how many Shillings must each have?

Thus,

Thus,

First I suppose *A.* shall have 33 *s.* then *B.* must have 36, and *C.* 40, but the Sum of 33, 36, and 40 makes 109, and should have been but 100, therefore it is 9 too much.

Secondly, I suppose *A.* shall have 31 *s.* then *B.* must have 34, and *C.* 38; but 31, 34, and 38 are 103, which should have been but 100, therefore I am 3 too much, and the Errors are both Excesses.

279	+	99	33
6)180	(30	31	180
18	X	33	3
—	(30	—	99
00	+	31	9
—	3	—	279
	6		
	9		

So that *A.* had 30 *s.* *B.* 33 *s.*
and *C.* 37, which together
makes 100 Shillings.

Proof.

30
33
37

100 Shill.

Quest. 8. A Man gave away his Estate in this Manner to *A.* $\frac{1}{2}$, and he gave back 10 *l.* to *B.* $\frac{1}{3}$, and he gave back 6 *l.* and to *C.* $\frac{1}{4}$, and he gave back 4 *l.* last of all he had 16 *l.* remaining, what was his Estate?

First

Double Position

225

First Supposition, suppose 60, then

Second Supposition; again, suppose 120 l. then

$$60. \frac{1}{2} 30 - 10 = 20$$

$$120. \frac{1}{2} 60 - 10 = 50$$

$$60. \frac{1}{3} 20 - 06 = 14$$

$$120. \frac{1}{3} 40 - 06 = 34$$

$$60. \frac{1}{4} 15 - 04 = 11$$

$$120. \frac{1}{4} 30 - 04 = 26$$

$$1 - 0 = 1$$

$$1 - 0 = 1$$

$$45$$

$$110$$

45 + 16 = 61 therefore
1 too much.

110 + 16 = 126 which
is 6 too much.

$$5) 240 (48$$

$$20$$

$$360$$

$$60$$

$$240$$

$$120$$

his Estate was 48 l.

$$40$$

$$40$$

X

$$48$$

For Proof.

$$48. \frac{1}{2} 24 - 10 = 14 \quad A.$$

$$48. \frac{1}{3} 16 - 06 = 10 \quad B.$$

$$48. \frac{1}{4} 12 - 04 = 08 \quad C.$$

$$32 + 16 = 48 \text{ l.}$$

Quest. 9. A certain Country Maid, having in her Basket a certain Number of Eggs, left (without breaking any) half that Number, and half an Egg at one Place, at a second Place half the Remainder and half an Egg, at a third Place half the Remainder, and half an Egg, and at last had one Egg left, how many had she at first?

Thus,

First suppose

$$63.$$

$$\frac{1}{2}$$

$$31$$

$$+ \frac{1}{2}$$

$$\frac{1}{2}$$

$$\text{is } 32$$

$$63$$

$$31$$

$$\frac{1}{2}$$

$$15$$

$$+ \frac{1}{2}$$

$$\frac{1}{2}$$

$$= 16$$

$$57$$

$$15$$

$$\frac{1}{2}$$

$$7$$

$$+ \frac{1}{2}$$

$$\frac{1}{2}$$

$$= 8$$

add 1

6 too little.

$$57$$

Q

Again,

Again suppose 23

$$\text{Then } 23. \frac{1}{2} \quad 11 + \frac{1}{2} + \frac{1}{2} = 12$$

$$11. \frac{1}{2} \quad 5 + \frac{1}{2} + \frac{1}{2} = 6$$

$$5. \frac{1}{2} \quad 2 + \frac{1}{2} + \frac{1}{2} = 3$$

add 1

63

75

23

X

(15)

6

—

1

123

22

Too little

22

1

5)75(15

5

25

X

So that the Maid had 15 Eggs; for the $\frac{1}{2}$ of 15 is $7\frac{1}{2}$, to which adding $\frac{1}{2}$ the Sum is 8, left at the first Place, then she had 7 left; then the $\frac{1}{2}$ of 7 is $3\frac{1}{2}$, to which add $\frac{1}{2}$ maketh 4, which she left at the second Place, then she had 3 left; the $\frac{1}{2}$ of 3 is $1\frac{1}{2} + \frac{1}{2} = 2$, which she delivered at the third Place: In all she left 14 Eggs, and had 1 left according to the Question.

Quest. 10. A Shepherd in the Time of War driving a Flock of Sheep, fell into the Hands of three Companies of plundering Soldiers, who forc'd him to deliver the $\frac{1}{2}$ of his Flock with a Sheep over and above to the first Company. Also $\frac{1}{2}$ of his remaining Flock with $\frac{1}{2}$ a Sheep to the second Company: Likewise the $\frac{1}{2}$ of the rest of his Flock with $\frac{1}{2}$ a Sheep to the third Company: All which Divisions the Shepherd exactly performed without killing a Sheep, and then there remained only 20 Sheep for himself. The Question is, to find how many Sheep the Shepherd had in his Flock at first?

Answer, 167.

For

Double Position.

227

For the first, suppose 287 Sheep.

$$\begin{array}{r}
 \text{Then } 287. \quad \frac{1}{2} \quad 143 \quad + \quad \frac{1}{2} \quad 143 \quad = \quad 286 \\
 143. \quad \frac{1}{2} \quad 71 \quad + \quad \frac{1}{2} \quad 71 \quad = \quad 142 \\
 71. \quad \frac{1}{2} \quad 35 \quad + \quad \frac{1}{2} \quad 35 \quad = \quad 70
 \end{array}$$

15 too little

$$\begin{array}{r}
 252 \\
 \text{add } 20 \\
 \hline
 272
 \end{array}$$

$$\begin{array}{r}
 272 \\
 \hline
 272
 \end{array}$$

Secondly, suppose 367 Sheep.

$$\begin{array}{r}
 \text{Then } 367. \quad \frac{1}{2} \quad 183 \quad + \quad \frac{1}{2} \quad 183 \quad = \quad 366 \\
 183. \quad \frac{1}{2} \quad 91 \quad + \quad \frac{1}{2} \quad 91 \quad = \quad 182 \\
 91. \quad \frac{1}{2} \quad 45 \quad + \quad \frac{1}{2} \quad 45 \quad = \quad 90
 \end{array}$$

25 too little

$$\begin{array}{r}
 332 \\
 \text{add } 20 \\
 \hline
 352
 \end{array}$$

By this second Position I find 25 too little.

$$\begin{array}{r}
 7175 \quad - \quad 5505 \\
 \hline
 1670
 \end{array}$$

287 1670 367

X (167 Sheep at first.)

$$\begin{array}{r}
 15 \quad - \quad 25 \\
 \hline
 10
 \end{array}$$

So that it appears that the Shepherd had 167 Sheep in his Flock at first.

Q 2

The

For

The PROOF

1. First Company, $\frac{1}{2}$ of 147 is 83. $\frac{1}{2}$, to which add $\frac{1}{2}$ the Sum, is 84, which was delivered to the first Company of plundering Soldiers, then there remained to the Shepherd 83 Sheep.

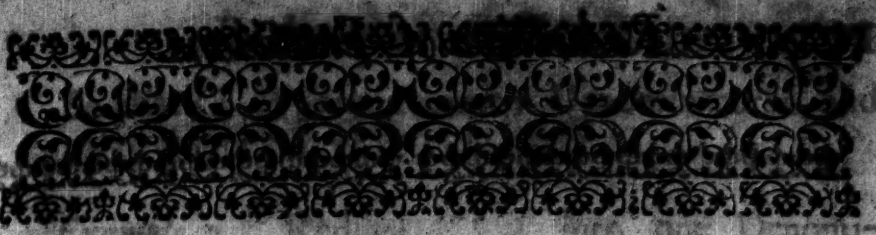
2. Second Company, $\frac{1}{2}$ of 83 is 41. $\frac{1}{2} + \frac{1}{2}$ is 42 the Number of Sheep he deliver'd to the second Company, and then there remained to the Shepherd 41.

3. Third Company, $\frac{1}{2}$ of 41 is 20. $\frac{1}{2} + \frac{1}{2}$ is 21, the Number of Sheep he delivered to the third Company; and so at length there remain'd 20 Sheep to the Shepherd, as the Question required.

	For the first Company took	84	Sheep
167	Second Company took	42	
147	Third Company took	21	
20	Sheep left.	147	
		20	Sheep left.

Thus much for Arithmetick in whole Numbers.

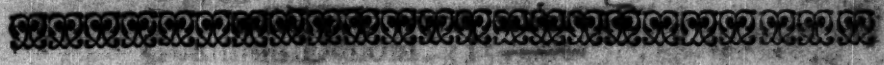




Reduction

C H A P. XXIII.

The Doctrine of Vulgar Fractions.



Numeration, on the Definition of a Fraction.

I. A FRACTION or broken Number is a Part, or Parts of many whole Numbers. For as whole Numbers take their Beginning from 1, and so continue in Number without End, so the said whole Number may be dissolved into Parts or Pieces infinite.

Therefore to attain unto the Knowledge of Fractions, you must acquaint yourself with these two Terms, viz. Numerator and Denominator.

Numerator	2	2	3	7	10	13	240
Denominator	5	3	4	9	12	20	450

signifieth two fifth Parts of any whole Number, or Unity, and so of all the rest.

Q3 Reduction

2030 Reduction of Fractions.

Reduction.

Definition. Eacheth to bring Integers into Fractions, or contrarywise Fractions of divers Denominations into one, or what you shall want, or desire.

To reduce proper Fractions.

Note, When 3 or more Fractions, which have unequal Denominators are given to be reduced.

The RULE is.

Multiply the Numerator of each Fraction, and all the Denominators, except its own, continually one into another; so are the several Products arising from such continual Multiplication a new Numerator.

Lastly, multiply all the Denominators together continually, so is the Product a common Denominator to all the new Numerators.

As for EXAMPLE.

Reduce $\frac{1}{3}$ and $\frac{4}{5}$ into one common Denominator.

Thus,

$$\begin{array}{r} 3 \quad 4 \\ \hline 4 \quad 5 \\ \hline 15 \quad 16 \\ \hline 20 \quad 20 \end{array}$$

For 3 times 5 is 15,
and 4 times 4 is 16,
new Numerators,
and 4 times 5 is 20.

So

Reduction of Fractions. 231

So that $\frac{1}{20}, \frac{1}{20}$ are common Denominators, and equal to $\frac{1}{4}$ and $\frac{1}{5}$.

Example 2. Reduce $\frac{1}{3}, \frac{2}{7}, \frac{1}{5}$ into one Denomination.

Thus,

$$\begin{array}{r} 352 \quad 270 \quad 175 \\ \hline \end{array}$$

$$\begin{array}{r} \frac{1}{3} \quad \frac{2}{7} \quad \frac{1}{5} \\ \hline \end{array}$$

Common Denom. 315

So that $\frac{105}{315}, \frac{90}{315}, \frac{63}{315}$ are equal to $\frac{1}{3}, \frac{2}{7}, \frac{1}{5}$ as shall be hereafter demonstrated by Abbreviation of which in its due Place.

Example 3. Likewise Reduce $\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{6}, \frac{1}{12}$ into one Denomination.

Being reduced per your Rule are

Nume. 15120	18144	25200	13440	36720
<u>Denom. 30240</u>	<u>30240</u>	<u>30240</u>	<u>30240</u>	<u>30240</u>

Reduction of Fractions of Fractions.

A Fraction of a Fraction is that, which hath more Numerators and Denominators than one, and is to be discovered by the Word [Of] which is interpos'd between the Parts of such Compound Fraction, as $\frac{2}{3}$ of $\frac{1}{4}$ is a Fraction of a Fraction of an Integer of a Pound Sterling, or any Thing else, either of Weights, Measures, or any other Kinds.

232 Reduction of Fractions.

The RULE.

Multiply all the Numerators together, and take the Product thereof for a Numerator, and likewise multiply all the Denominators together, and make the Total a new Denominator.

As for EXAMPLE.

Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ into a single Fraction; being reduced it makes $\frac{1}{4}$ and is a single Fraction.

$$\frac{\frac{1}{2} \text{ of } \frac{2}{3} \text{ of } \frac{3}{4}}{6}$$

$$\frac{1}{2} \text{ of } \frac{2}{3} \text{ of } \frac{3}{4}$$

$$24$$

Again, reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ into a single Fraction.

$$\begin{array}{r} \text{Numer.} \quad 720 \quad | \quad 720 \quad | \quad 720 \quad | \quad 720 \\ \hline \text{Common Denom.} \quad 6720 \end{array}$$

$$\frac{720}{6720}$$

To reduce improper Fractions into whole Numbers.

An improper Fraction is that, whose Numerator is either greater, or at least equal unto the Denominator; so this Fraction $\frac{8}{4}$ that is eight fourths, is called an improper Fraction, and so is this $\frac{5}{4}$, for indeed a Fraction of this Kind, may well be surnamed improper, since it is always greater than an entire Unity,

or

Reduction of Fractions. 233

or at least equal unto it. An Improper Fraction may be reduced into its equivalent whole Number or mixt Number in this Manner.

The RULE.

Divide the Numerator by the Denominator, so is the Quotient the whole Number or mixt Number sought.

As for EXAMPLE,

Reduce $2\frac{2}{3}$ into its equivalent mixt Number, the Number will be 5 l. $\frac{2}{3}$ or 5 l. 4 s. for if 26 be divided by 5, the Quotient is 5. $\frac{2}{3}$.

$$\begin{array}{r} 5 \overline{)26} 5 \frac{2}{3} \\ 25 \\ \hline 1 \end{array}$$

Reduce $1\frac{2}{3}$. Facit 2 l. $\frac{2}{3}$.

$$\begin{array}{r} 4 \overline{)10} 2 \frac{2}{3} \\ 8 \\ \hline 2 \end{array}$$

Reduce $4\frac{2}{3}$. Facit 33. $\frac{1}{3}$.

$$\begin{array}{r} 12 \overline{)406} 33 \frac{1}{3} \\ 36 \\ \hline 46 \end{array}$$

$$\begin{array}{r} 46 \\ 36 \\ \hline 10 \end{array}$$

Also the improper Fraction $1\frac{1}{4}$ will be reduced into the whole Number 13.

$$\begin{array}{r} 4 \overline{)52} 13 \\ 4 \\ \hline 12 \\ 12 \\ \hline 0 \end{array}$$

234 Reduction of Fractions.

To reduce a mixt Number into an improper Fraction.

A mixt Number is that, which besides the integral Parts, or entire Unities of which it consists, hath also a Fraction annexed unto it thus: $2\frac{1}{2}$, *Facit* $7\frac{1}{2}$ of a Mile.

A mixt Number may be reduced into an improper Fraction by this

R U L E.

Multiply the integral Part (or whole Number) by the Denominator of the Fraction, and to the Product add the Numerator, and that Sum place over the Denominator; so this new Fraction shall be equal to the mixt Number given.

As for EXAMPLE.

Reduce $2\frac{1}{9}$. *Facit* $\frac{19}{9}$. For 9 times 2 is 18, and 5 is 23, which is equal unto $\frac{19}{9}$.

Again, reduce this mixt Number $5\frac{1}{5}$ into an improper Fraction. *Facit* as by the Rule $\frac{26}{5}$.

To reduce a whole Number into an improper Fraction.

Multiply the given Number by the intended Denominator, and Place the Product for a Numerator over it.

As

Reduction of Fractions. 235

As for *EXAMPLE.*

Reduce 15 into a Fraction, whose Denominator shall be 12. *Facit* $\frac{5}{4}$ for 15 multiplied by 12 *facit* $\frac{180}{12}$.

$$\begin{array}{r} 15 \\ 12 \\ \hline 180 \end{array}$$

Reduce 36 into a Fraction whose Denominator shall be 20.

$$\begin{array}{r} 36 \\ 20 \\ \hline 720 \end{array}$$

Facit $\frac{9}{5}$.

Reduce 24 into an improper Fraction, by setting 1 under it for a Denominator, it is a Fraction improper.

Thus $\frac{24}{1}$.

Reduction or Abbreviation, or Some Rules whereby the Manner to abbreviate.

1. Two Numbers being given, their greatest common Measure, (that is the greatest Number, which will measure or divide both Numerator, and Denominator without leaving any Remainder) may be found in this Manner, *viz.*

Divide the greater Number by the lesser, then divide the last Divisor by the Remainder, and so continue dividing the last Divisors by the Remainders, until there be no Remainder, (neglecting the Quotients;) so is the last Divisor the greatest common Measure unto the Numbers given.

As

256 Reduction of Fractions

As for **EXAMPLE**

Reduce $\frac{3077}{1086}$ into a Fraction whose Denominator shall be 181. Thus;

$$\begin{array}{r} 3077(1 \mid 1086)3077(2 \mid 905)1086(1 \mid 181)905(3 \mid 509) \\ \hline 1086 \qquad 905 \qquad 181 \qquad 0 \end{array}$$

So that 181 is the common Measure.

$$\begin{array}{r} 181)3077(17 \\ \underline{181} \\ 1267 \\ \underline{1267} \\ 0 \end{array} \qquad \begin{array}{r} 181)4163(23 \\ \underline{181} \\ 362 \\ \underline{362} \\ 0 \end{array}$$

Reduce $\frac{3077}{1086}$ into an improper Fraction by setting 1 under it for a Denominator, it is a Fraction improper.
 Facit $\frac{17}{181}$ is equal to $\frac{17}{181}$.

Examp. 2. Again abbreviate $\frac{26}{13}$ thus; as by the Rule.

$$\begin{array}{r} 26)91(3 \\ \underline{78} \\ 13 \end{array} \qquad \begin{array}{r} 13)26(2 \\ \underline{26} \\ 0 \end{array}$$

So that 13 is the common Measure.
 Facit $\frac{3}{2}$ common Measure $\frac{3}{2}$ equal to $\frac{3}{2}$.

But here you are to observe nicely, that if the greatest common Measure unto the Numerator and Denominator be 1, such Fraction is in its lowest Terms already, so the Fraction $\frac{17}{181}$ cannot be reduced into

into lower Terms, because the greatest common Measure will be found 1. The like may happen of many other Numbers. And although the last be a general Rule for the abbreviating, or bringing of Fractions into their lowest Terms, yet Experience daily shews to us other practical Rules, which in some Cases will be more easily and readily found out, as is well known unto those, whose Practice is continually used, viz. When you shall observe the Numerator and Denominator to be even Numbers, you may measure them by 2, as $\frac{4}{8}$ as

divide the Product by the Denominator, so that $\frac{4}{8}$ comes to $\frac{1}{2}$.

Again, when the Numerator and Denominator, shall each of them End with 5 or 0, they may be both measured by 5, so

$$\frac{5}{47} \quad \frac{10}{94} \quad \frac{15}{141} \quad \frac{20}{188} \quad \frac{25}{235} \quad \frac{30}{282} \quad \frac{35}{329} \quad \frac{40}{376} \quad \frac{45}{423} \quad \frac{50}{470}$$

Whensoever you can espy any other Number, which will exactly Measure both Numerator and Denominator, you may then divide them.

Thus $4 \frac{4}{8} = \frac{1}{2}$ thus $\frac{10}{40} = \frac{1}{4}$

Likewise if the Numerator and Denominator, do each of them end with a Cypher or Cyphers, cut off equal Cyphers in both, so will the Fraction be reduced into its lowest Value.

So $\frac{40}{100}$ is reduce to $\frac{4}{10}$, or $\frac{20}{100}$ is $\frac{2}{10}$

$$\frac{40}{100} = \frac{4}{10} \quad \frac{20}{100} = \frac{2}{10}$$

I will take a Sum of Digits and you may better know

To find the Value of a single Fraction in the known Parts of an Integer.

The Value of a single Fraction in the known Parts of an Integer, may be found in this Manner, viz. multiply the Numerator of the Fraction propounded, by the Number of known Parts of the next inferior Denomination, which are equal to the Integer, and divide that Product by the Denominator; so is the Quotient the Value of the Fraction in that inferior Denomination; and if there happen to be any Fraction in the Quotient, you may find the Value thereof in the next inferior Denomination, by the same Rule, and so proceed till you come to the least known Parts: A few Examples in the Operation, will make it more plain and easy than Words can so aptly express.

$$\begin{array}{r} 20 \\ 9 \end{array} \text{ s.}$$

$$\begin{array}{r} 16 \overline{) 180} \\ 160 \\ \hline 20 \\ 16 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 12 \text{ d.} \\ 4 \text{ d.} \\ \hline 16 \overline{) 48} \\ 48 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 16 \overline{) 48} \\ 48 \\ \hline 0 \end{array}$$

As for EXAMPLE.

What is the Value of $\frac{9}{20}$ of a Pound Sterling thus found; multiply the Numerator 9 by 20 (which are equal to a Pound Sterling,) the Product is 180, which being divided by 16, the Quotient is 11. $\frac{4}{16}$ Shill. In like Manner multiply the Numerator 4 by 12 the Number of Pence in a Shilling, the Product is 48, which being divided by the common Denominator 16, the Quotient is 3 Pence.

But for the better Information of the Learner, I will take a Sum of Division and you may better know

Reduction of Fractions.

239

know what the Remainder amounts to, divide 3201531 by 19.

19)3201531(168501. $\frac{12}{19}$ Quotient.

19

130

114

161

152

95

95

031

19

12

20

19)240(12

19

50

38

12

12

19)144(7

133

11

4

19)44(2 farth. $\frac{4}{19}$

38

6

Now to know what the Fraction is, the integral Part being Pounds, by the Rule, reduce the 12 into Shillings by 20, *facit* 12 s. and 12 a Fraction remaineth, which I multiply by 12, and the Product divide by 19 and it maketh 7 d, and 11 remains, which I bring into Farthings; by multiplying by 4, and dividing the Product by 19, maketh 2 in the Quotient, which is 2 Farthings, and 6 for a Fraction or $\frac{6}{19}$.

Thus

Thus it plainly appears, That if 3201531 Pounds, were to be distributed among 19 Men, each Man must have 168501 Pounds, 12 Shillings, 7 Pence a Farth. and $\frac{1}{19}$; so that 'tis more than 2 Farthings, but farther our Money runs not.

Some Examples with their Answers

What is the Value of $\frac{27}{29}$ of a Pound Sterl.

Answer, 18 s. 7 d. 1 far. $\frac{27}{29}$.

Thus found.

27	29
20	29
— s.	—
29)540(18	—
29	—
—	—
250	—
232	—
—	—
18	—
12	—
— d.	—
29)216(7	—
203	—
—	—
13	—
4	—
— far.	—
29)52(1. $\frac{27}{29}$	—
29	—
—	—
23	—

What is the Value of $\frac{1}{12}$ of a Pound Sterling.

Answer, 14 s. 8 d.

What

Reduction of Fractions. 241

What is the Value of $\frac{2}{37}$ of a Pound Sterling.

Answer 4 s. 1 d. $\frac{2}{37}$.

What is $\frac{1}{21}$ of a hundred Weight ?

Answer, 3 qrs 1 lb. 5 oz. 2 drams, 1 scruple.

What is $\frac{1}{37}$ lb. Troy.

Answer, 4 oz. 7 pwt. 23 gr. $\frac{1}{37}$.

What is $\frac{4}{5}$ of a Year?

Answer, 229 Days, 7 Hours, 12 Minutes.

What is the Value of $\frac{1}{4}$ of $\frac{1}{6}$ of $\frac{1}{10}$ of a Pound Sterling, being reduced are $\frac{1}{240}$.

Answer, 11 s. 3 d.

Then,

135

20

240

300

240

60

12

240)720(3 d.

720

0

Thus much for *Reduction of Fractions*, which the Learner ought well to understand ; proceed we now to *Addition*.

R

Addi:

Addition of Vulgar Fractions.

If your Fractions to be added have a common Denominator, then add all the Numerators together, and place their Sum for a Numerator, to the common Denominator, which new Fraction is the Sum of all the given Fractions; and if they are mixt or improper, reduce them to a whole or mixt Number.

As for E X A M P L E.

Example 1. Add $\frac{2}{3}$ and $\frac{1}{3}$ of any Thing together.

Facit $\frac{3}{3}$ or Unity.

Examp. 2. Add $\frac{7}{8}$, $\frac{5}{8}$ and $\frac{1}{8}$ with $\frac{6}{8}$.

Facit $1\frac{1}{8}$ or $2\frac{1}{8}$.

For 7	8)17(2.
5	16
3	—
2	1
—	—
17.	

Examp. 3. Add $\frac{2}{3}$ and $\frac{1}{3}$ together?

Facit 1.

Vulgar Fractions.

243

$\frac{3}{5} \times \frac{3}{5}$

10

9

19 or 1. $\frac{4}{19}$

5

Examp. 4. What is the Sum of $\frac{3}{5}$, $\frac{2}{8}$, $\frac{9}{12}$ and $\frac{1}{12}$.

The Fractions reduced to a common Denominator are,

Num.	2880	4200	4320	4400
	<u>4800</u>	<u>4800</u>	<u>4800</u>	<u>4800</u>

The Sum of the Numerators are,

$$\frac{118}{48} \div \frac{20}{20} \text{ or } \frac{118}{48} = 3. \frac{7}{24}$$

The Sum required is a mixt Number, viz. $3. \frac{7}{24}$.

Of Compound Fractions.

Examp. 5. Add $\frac{1}{3}$ and $\frac{2}{3}$ of $\frac{1}{4}$ together.

$\frac{1}{3} \times \frac{2}{3}$

$\frac{2}{3}$ of $\frac{1}{4}$ is $\frac{2}{12}$

18

18

Facit $\frac{22}{30}$.

5

1

5

23

add.

5

30

R $\frac{2}{3}$

Ex

Examp. 6. What is the Sum of $\frac{1}{2}$ of $\frac{1}{3}$ and $\frac{2}{3}$ of $\frac{1}{4}$ of $\frac{1}{2}$.

Reduce $\frac{2}{3}$ of $\frac{1}{4}$ of $\frac{1}{2}$ into a simple Fraction, and it maketh $\frac{1}{12}$, which reduced with the other two Fractions, viz. $\frac{1}{2}$ of $\frac{1}{3}$, are

Add the Num.	New Num.	3456	3840	3150
3456				
3840	Denom.	5760	5760	5760
3150				

5760	) 10446	(1. $\frac{4686}{5760}$)	Facit 1 l. $\frac{4686}{5760}$.
	5760		
	4686		

Of Fraction of Fractions.

Examp. 7. Add $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{1}{4}$ unto $\frac{4}{5}$ of $\frac{6}{7}$ unto a simple Fraction.

6	24
$\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{1}{4}$	$\frac{4}{5}$ of $\frac{6}{7}$
24	35
add	
6 X 24	35
24 X 35	24
576	140
210	70
786	840 Denom.
840	

Remember to multiply cross-wise thus, 24 multiplied by 24 is 576, and 6 by 35 is 210, which being added, makes 786 a new Numerator to the Denom. 840.

Note,

Note, I would have you here take Notice, that the Fractions in all their Operations, are ever supposed to be simple Fractions of Integers, which have one and the same particular Denomination; (that is to say) if one of the Fractions given to be added, is a Fraction of a Pound Sterling, all the rest are to be esteemed Parts of a Pound Sterling, and the like is to be understood of all other Denominations.

Note also, When Fractions of Integers of different Denominations, are given to be added; they must first of all be reduced into Fractions of Integers, which shall have one and the same particular Denomination, and then you may add them together.

As for *EXAMPLE*.

If $\frac{2}{3}$ of a Pound Sterling, $\frac{1}{2}$ of a Shilling, and $\frac{1}{8}$ of a Penny were given to be added, reduce the two latter into Fractions of a Pound Sterling, viz. $\frac{1}{2}$ of a Shilling is $\frac{1}{4}$ of $\frac{1}{20}$ of a Pound Sterling, which Fraction being reduced makes $\frac{1}{80}$: Likewise $\frac{1}{8}$ of a Penny is $\frac{1}{8}$ of $\frac{1}{20}$ of $\frac{1}{12}$ of a Pound Sterling, which being reduced is $\frac{1}{192}$. Lastly $\frac{2}{3}$ $\frac{1}{80}$ and $\frac{1}{192}$, being reduced and added will be found to make $\frac{24}{3456}$ or $\frac{1}{144}$ of a Pound Sterling.

When mixt Numbers are given to be added, find first the Sum of all the Fractions, then add the Integer, or Integers, (if there be any found) in the Sum of the Fractions, unto the whole Numbers, and collect them as before taught.

So if $3\frac{1}{2}$, $4\frac{1}{3}$, and $16\frac{1}{6}$ were given to be added, their Sum will be found to be $24\frac{1}{2}$.

Thus found by the Operation.

The single Fractions $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$ will be, $\frac{4}{12}$, $\frac{4}{12}$, $\frac{2}{12}$ which Numerators being added make 1. $\frac{10}{12}$, and the Sum of the whole Numbers collected together, to wit, 3, 4, and 16, makes 23, therefore the Total is $24 \frac{10}{12}$. For Answer 24 l. $\frac{10}{12}$ of a Pound, is the Sum of the mixt Numbers given to be added.

Subtraction of Vulgar Fractions.

The RULE.

WHEN the Numbers given are both single Fractions, and have one and the same Denominator, subtract the lesser Numerator from the greater, and place the Remainder over the common Denominator, so is such new Fraction the Difference between the Fractions given.

As for EXAMPLE.

Examp. 1. Subtract $\frac{1}{8}$ from $\frac{2}{8}$, the Difference is $\frac{1}{8}$ or $\frac{1}{8}$.

Examp. 2. Subtract $1 \frac{2}{11}$ from $1 \frac{1}{11}$, there Remains

But when they have unequal Denominators, reduce them into Fractions of the same Value, which shall have a common Denominator, and then find their Difference as by the last Rule.

Examp. 3.

Examp. 3. Subtract $\frac{2}{3}$ from $\frac{2}{3}$ rest $3\frac{1}{3}$ for $\frac{2}{3}$ and $\frac{2}{3}$ being reduced will be $\frac{4}{6}$ and $\frac{4}{6}$, so the Difference you see to be $\frac{1}{6}$.

Examp. 4. What is the Difference between $\frac{1}{2}$ and $\frac{1}{3}$ of $\frac{1}{8}$. *Facit* $\frac{1}{24}$ or $\frac{1}{24}$.

For $\frac{1}{3}$ of $\frac{1}{8}$ being reduced to a simple Fraction, viz. $\frac{1}{24}$, then proceed as before taught, and you will find it.

Answer, $\frac{1}{24}$ or $\frac{1}{24}$.

Of Mixt Numbers.

When one of the Numbers given is a whole Number, or a mixt Number, or if either of them are mixt Numbers, reduce such whole or mixt Numbers into an improper Fraction or Fractions, and then Work as before taught.

Subtract $7\frac{1}{3}$ from 12 , the Remainder is found $4\frac{2}{3}$ for these two Fractions will be found to be $\frac{2}{3}$ and $\frac{4}{6}$, whose Difference is $\frac{2}{6}$ or $\frac{1}{3}$.

In like Manner $3\frac{1}{2}$ being to be subtracted from $5\frac{1}{4}$, the Remainder will be found $1\frac{1}{2}$ or $2\frac{1}{2}$, as by the subsequent Operation.

$$\begin{array}{r} 5\frac{1}{4} \\ - 3\frac{1}{2} \\ \hline 1\frac{1}{2} \end{array}$$

So there is $1\frac{1}{2}$ or $2\frac{1}{2}$ as before.

69 12 Deno. before.
44 12 Deno. before.
25 Num. For 4 multiplied by 3 is 12 for Numerator.
R 4 From

From 12 take $7\frac{1}{3}$ thus,

$$\begin{array}{r} 12 \\ - 7\frac{1}{3} \\ \hline 5\frac{2}{3} \end{array}$$

$$\begin{array}{r} 12 \\ - 5 \\ \hline 7 \end{array}$$

$$\begin{array}{r} 60 \\ - 38 \\ \hline 22 \end{array}$$

Subtr. 10

Rest $\frac{2}{3}$

22

For Answer, remains $\frac{2}{3}$ or $4\frac{2}{3}$.

To subtract a whole Number from a mixt Number.

When a whole Number is given to be subtracted from a mixt Number, subtract the said whole Number, from the whole Part of the mixt Number; and unto the Remainder annex the fractional Part of the mixt Number given, so is the mixt Number so found the Difference sought.

As for *EXAMPLE*.

Received $\frac{2}{3}$ of a Pound, laid out 7 l. what remains.

$$\begin{array}{r} 24 \\ - 7 \\ \hline 17 \end{array}$$

Subtr.

17. $\frac{2}{3}$ Remains, as by the Rule.

Received 15 l. of a Pound, laid out 9 l.

$$\begin{array}{r} 15 \\ - 9 \\ \hline 6 \end{array}$$

For if you receive 15 l. 15
And lay out 9

6 l. $\frac{1}{2}$ Remains There will rest 6 l. 15

To

To subtract a Fraction from an Integer.

When a Fraction is given to be subtracted from an Integer, subtract the Numerator from the Denominator, and place that which remains over the Denominator, which new Fraction is the Difference sought.

So $\frac{2}{3}$ being subtracted from an Integer or 1. the Remainder is $\frac{1}{3}$.

Also $\frac{1}{9}$ being subtracted from 1, the Remainder is $\frac{8}{9}$.

A Fraction from a whole Number greater than 1.

When a Fraction is given to be subtracted from a whole Number greater than 1, subtract the said Fraction from one of the Integers given by the last Rule; so the remaining Fractions being annexed to the Number of Integers lessened by 1, will give the Remainder.

Thus $\frac{2}{3}$ being subtracted from 6, the Remainder is $5\frac{1}{3}$.

Also $\frac{7}{12}$ from 39 rest $38\frac{5}{12}$.

Or $\frac{4}{9}$ from 2. rests $1\frac{5}{9}$.

To subtract a whole Number and a Fraction from a whole Number and a Fraction.

First reduce your Fractions into one Denomination, then subtract the one Numerator from the other

Subtraction of

other; and for the Integers subtract as in whole Numbers.

As for **EXAMPLE.**

Received $30\text{ l. } \frac{1}{2}$, laid out $10\text{ l. } \frac{1}{2}$. First reduce $\frac{1}{2}$ and $\frac{1}{2}$ into one Denomination.

$$\begin{array}{r} 30\text{ l. } \frac{1}{2} \\ 10\text{ l. } \frac{1}{2} \\ \hline \end{array}$$

Rest $20\text{ l. } \frac{1}{2}$

$$\begin{array}{r} \text{Again, Received } 100\text{ l. } \frac{2}{3} \\ \text{Paid } 93\text{ l. } \frac{1}{3} \\ \hline \end{array}$$

Remains $7\text{ l. } \frac{1}{3}$

Thus,

Reduce the Fractions as you find by the Operation.

$$\frac{1}{2} = \frac{3}{6} \quad \frac{1}{3} = \frac{2}{6}$$

Of Fractions of Fractions.

When Fractions of Fractions are to be subtracted, they must be reduced into single Fractions, then subtract as before taught.

Subtract $\frac{1}{2}$ of $\frac{2}{3}$ from $\frac{1}{4}$ of $\frac{3}{5}$.

Being

Being reduced they are $\frac{1}{3}$ and $\frac{1}{4}$.

$$\begin{array}{r} 4 \text{ to } 1 \text{ or } 1 \text{ by } 4 \\ \hline 5 \quad 9 \\ \hline \frac{1}{3} \quad \frac{1}{4} \\ \hline \end{array}$$

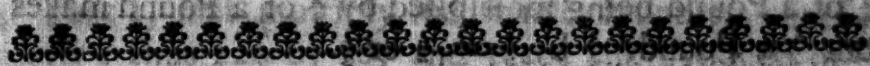
Rest $\frac{1}{12}$.

15

To discern the greater of two Fractions.

N. B. Those Fractions are always accounted the greatest, whose Numerator multiplied by the Denominator of the other Fraction, maketh the greatest Number.

Thus $\frac{2}{3}$ is greater than $\frac{1}{4}$; for 7 times 5 is greater than 8 times 3.



Multiplication of Vulgar Fractions.

The RULE.

IN Multiplication of Vulgar Fractions, you must Note, that when the Numbers given to be multiplied are both single Fractions, multiply the Numerators one by the other, so is the Product a new Numerator; also multiply the Denominators one by the other, so is the Product a new Denominator, which new Fraction is the Product sought.

As

As for EXAMPLE.

Multiply $\frac{2}{3}$ by $\frac{1}{4}$. Facit $\frac{1}{6}$ or $\frac{1}{6}$.

So $\frac{2}{3}$ and $\frac{1}{4}$ being given to be multiplied, the Product will be $\frac{1}{6}$.

Also $\frac{2}{3}$ multiplied by $\frac{1}{4}$ facit $\frac{1}{6}$.

In this Rule of *Multiplication of Vulgar Fractions*, it might seem somewhat strange to many, that $\frac{1}{2}$ of a Pound multiplied by $\frac{1}{2}$ of a Pound, should $\frac{1}{2}$ by $\frac{1}{2}$ make but $\frac{1}{4}$ of a Pound; therefore I thought good in this Place to inform them (who shall see this Book) that as whole Numbers multiplied by whole Numbers do increase the Product; so proper Fractions multiplied by proper Fractions, do diminish the Product. For as 1 multiplied by 1 makes but 1, so that which is less than 1 being multiplied, must needs make less than 1, for $\frac{1}{2}$ of a Pound being multiplied by $\frac{1}{2}$ of a Pound makes but $\frac{1}{4}$ a Pound. $\frac{1}{2}$ by $\frac{1}{2} = \frac{1}{4}$ or $\frac{1}{4}$.

To multiply mixt Numbers.

Reduce such whole Number, or mixt Number or Numbers, into an improper Fraction or Fractions, and then the Operation will be the same as in the last Rule.

So $8\frac{2}{3}$ being given to be multiplied by 5, the Product will be found $43\frac{1}{3}$, viz. $8\frac{2}{3}$ is $\frac{26}{3}$ also 5 is $\frac{5}{1}$, then multiplying 26 by 5, the Product is 130 for a new Numerator, also multiplying 3 by 1, the Product is 3 for a new Denominator, hence $\frac{130}{3}$ or $43\frac{1}{3}$.

In like Manner $7\frac{1}{2}$ being multiplied by $5\frac{2}{3}$, the Product will be found 42.

$$\begin{array}{r} 7\frac{1}{2} \text{ by } 5\frac{2}{3} \\ \hline 15 \qquad 28 \\ \hline 2 \qquad \qquad 5 \end{array}$$

$$\begin{array}{r} 1\frac{1}{2} \text{ by } 2\frac{2}{3} \\ \hline \text{For } 28 \text{ by } 5 \\ 15 \qquad \qquad 10 \\ \hline 10 \qquad 42 \qquad 0 \qquad 42 \end{array}$$

Note, There may be other Rules prescribed, for the multiplication of mixt Numbers; but because the Operation by such Rules, would be little or nothing breifer than the Operations of the last Rule, I shall therefore make use of no other Rule than this, which is now made use of by Measurers, in their measuring of Joyners, Carpenters, and Bricklayers Works, commonly called *Cross Multiplication*.

Thus if it be required to multiply 120 Feet $\frac{1}{4}$ by 48 Feet $\frac{1}{2}$, first multiply the whole Numbers continually; thus 120 by 48, and place the Products orderly one under the other.

Thus the whole Numbers make 5760, then multiply alternately or Cross-wise, viz. take $\frac{1}{4}$ of 48, which is 12, also take $\frac{1}{2}$ of 120, which is 60, orderly to be added to the former. Lastly, add all together, and to the Sum annex the Product of the two Fractions, to wit in this Example, the Product of the Multiplication of $\frac{1}{4}$ by $\frac{1}{2}$, which is $\frac{1}{8}$, so the total Product required, will be 5832. $\frac{1}{8}$ as you see by the Operation in the Margent.

$$\begin{array}{r} 120. \frac{1}{4} \\ 48. \frac{1}{2} \\ \hline 960 \\ 480 \\ \hline 5760 \\ 12 \\ 60 \\ \hline 5832. \frac{1}{8} \end{array}$$

In

In like Manner, if $18. \frac{1}{2}$ be multiplied by $40. \frac{1}{3}$ the Product will be $746. \frac{1}{6}$.

And if $29. \frac{1}{2}$ Feet be multiplied by 50 Feet, the Product will be 1475, as by the Operation is manifest.

$$\begin{array}{r}
 18. \frac{1}{2} \\
 40. \frac{1}{3} \\
 \hline
 720 \\
 20 \\
 6. \frac{1}{6} \\
 \hline
 746
 \end{array}$$

$$\begin{array}{r}
 29. \frac{1}{2} \\
 50 \\
 \hline
 1450 \\
 25 \\
 \hline
 1475 \text{ Feet.}
 \end{array}$$

So if you multiply $4. \frac{1}{2}$ by $4. \frac{1}{2}$ or $4 \text{ s. } 6 \text{ d.}$ by $4 \text{ s. } 6 \text{ d.}$

$$\begin{array}{r}
 4. \frac{1}{2} \\
 4. \frac{1}{2} \\
 \hline
 16 \\
 2 \\
 2. \frac{1}{4} \\
 \hline
 20. \frac{1}{4}
 \end{array}$$

$$\begin{array}{r}
 \text{s.} \quad \text{d.} \quad \text{s.} \quad \text{d.} \\
 4 : 6 \text{ by } 4 : 6 \\
 4 : 6 \\
 \hline
 16 \\
 2 \\
 2. \frac{1}{4} \\
 \hline
 20 \text{ s. } 3 \text{ d.}
 \end{array}$$

For by multiplying cross-wise, saying, 6 times 4 is 24 d. which is 2 s. and so alternately again it is 2 s. and the Fraction being the $\frac{1}{4}$ of a Shilling is 3 d. so that $4 \text{ s. } 6 \text{ d.}$ multiplied by $4 \text{ s. } 6 \text{ d.}$ is $20 \text{ s. } 3 \text{ d.}$

In

Vulgar Fractions.

255

In like Manner multiply 13 s. 4 d. by 13 s. 4 d. and it makes 8 l. 17 s. $\frac{1}{27}$ of a Penny.

Thus,

$$\begin{array}{r} 13. \frac{1}{3} \\ 13. \frac{1}{3} \\ \hline 39 \\ 13 \end{array}$$

$$\begin{array}{r} 169 \\ 4. \frac{1}{3} \\ 4. \frac{1}{3} \\ \hline 177. \frac{1}{3} \end{array}$$

$$\begin{array}{r} 177. \frac{1}{3} \\ \hline 1717 \end{array}$$

Fractions of $\frac{1}{3}$ and $\frac{1}{9} = \frac{1}{7}$

8 l. 17 s. $\frac{1}{27}$ is Equal to 8 d. $\frac{1}{27}$.

In like Manner multiply 3 Feet, 6 Inches by 3 Feet, 6 Inches.

Feet

$$\begin{array}{r} 3 : \frac{1}{2} \\ 3 : \frac{1}{2} \\ \hline 9 \end{array}$$

$$\begin{array}{r} 1 : \frac{1}{2} \\ 1 : \frac{1}{2} \\ \hline 1 \end{array}$$

$$\begin{array}{r} 12 : 0 : \frac{1}{4} \\ \hline \end{array}$$

Facit 12 Feet $\frac{1}{4}$ of an Inch.

To

256 Multiplication of

To put into it Money, Multiply 3 s. 6 d. by 3 s. 6 d.

$$\begin{array}{r}
 \text{s.} \quad \text{d.} \\
 3 : 6 \\
 3 : 6 \\
 \hline
 9 \\
 1 : 6 \\
 1 : 6 : 3 \\
 \hline
 12 : 0 : 3 \quad \text{Answ. 12 s. 3 far.}
 \end{array}$$

Multiply 5 l. 5 s. 5 d. by 5 l. 5 s. 5 d.

Answer, 27 l. 15 s. 7 d. $\frac{7}{12}$.

Operation by Fractions by the last Rule.

l. s. d.		
5 : 5 : 5		5 d. is $\frac{1}{12}$ of $\frac{1}{20}$ viz. $\frac{1}{240}$
20	$\frac{105}{20}$	$\frac{5}{240}$
105	105	
20	240	20
20	4200	5
400	210	100
12	25200	
New	100	
Den. 4800		
New Num. 253 00		
	48 00	

Vulgar Fractions.

257

$$\begin{array}{r} 48 \\ 48 \\ \hline 384 \\ 192 \\ \hline 2304 \end{array}$$

$$\begin{array}{r} 253 \text{ by } 253 \\ \hline 48 \quad 48 \end{array}$$

$$\begin{array}{r} 253 \\ 253 \\ \hline 759 \\ 1265 \\ 506 \\ \hline 64009 \end{array}$$

Answer, $\frac{44002}{2304}$ equal to 27 l. 15 s. 7 d. $\frac{1}{2}$. $\frac{1}{2}$.

The Proof of this Question by the Rule of Three Direct.

The P R O O F.

l.	l.	s.	d.	l.	s.	d.
1	5	5	5	5	5	5
20	20			20		
20	105			105		
12	12			12		
240	1265			1265		
				1265		
				6325		
				7590		
				2530		
				1265		
				1600225		

$$\begin{array}{r}
 12 \\
 240) 1600225 (6667(5515 \\
 \underline{1440} \dots 60 \\
 1602 \quad 66 \\
 \underline{1440} \quad 60 \\
 1622 \quad 67 \\
 \underline{1440} \quad 60 \\
 1825 \quad 7 \\
 \underline{1680} \quad \text{---} \\
 145 \\
 \text{---}
 \end{array}$$

$27 | 15 : 7 : \frac{22}{48} = \frac{1}{2} + \frac{1}{12}$
 $\frac{145}{240} | \frac{22}{48}$

By the stating any Question in this Kind (by the Rule of Three) all those Questions of multiplying Money by Money, are both easily comprehended and answered.

Again, Multiply 5 l. 19 s. 6 d. by 5 l. 19 s. 6 d. by the Rule of Three.

l.	l.	s.	d.	l.	s.	d.
1	5	19	6	5	19	6
20	20			20		
20	119			119		
12	12			12		
240	1434			1434		

$$\begin{array}{r} 240 \text{ --- } 1434 \text{ --- } 1434 \\ 1434 \end{array}$$

$$\begin{array}{r} 5736 \\ 4302 \\ 5736 \\ 1434 \end{array}$$

$$\begin{array}{r} 2056356 \end{array}$$

$$\begin{array}{r} 12 \\ 24 \overline{) 2056356} (8568 (71 \overline{) 4} \\ 192 \end{array}$$

$$0 \ 35 \overline{) 14} : 0 + \frac{1}{8}.$$

$$\begin{array}{r} 136 \end{array}$$

$$\begin{array}{r} 120 \end{array}$$

$$\begin{array}{r} 163 \end{array}$$

$$\begin{array}{r} 144 \end{array}$$

$$\begin{array}{r} 195 \end{array}$$

$$\begin{array}{r} 192 \end{array}$$

$$\begin{array}{r} 3 \end{array}$$

$$\frac{3}{24} \overline{) \frac{1}{8}}.$$

Some few Examples more for the right understanding of this Sort of Multiplication, now very much in Use.

S 2

Let

260

Multiplication of

Let 75 Feet, 9 Inches be multiplied by 17 Feet, 7 Inches.

Feet In. Feet Inches
75 : 9 by 17 : 7
17

525
75

1275
12 : 9
43 : 10
1 : 4

1332 : 11

Explanation.

Multiply cross-wise, viz.
17 by 9 makes 12 In. 9 pts,
75 by 7 makes 43 In. 10 pts.
and the Fraction 7 Inches,
and 9 Inches being added.
makes 16, and divided by
12, facit 1 Foo. 4 pts.

Answer, 1332 Feet, 11 Inches:

Feet Inches Feet Inches
Lastly 179 : 3 by 38 : 10
38 : 10

1432
537

6802

149 : 2 } Cross-wise.
9 : 6 }

1 : 1 Fraction makes.

6961 : 9

Answer, 6961 Feet, 9 Inches.

Divi-

Division of Vulgar Fractions.

The RULE.

WHEN the Numbers given are both single Fractions, multiply the Denominator of the Divisor by the Numerator of the Dividend, so is the Product a new Numerator. Also multiply the Numerator of the Divisor by the Denominator of the Dividend, so is the Product a new Denominator, which new Fraction is the Quotient sought.

As for EXAMPLE.

Quest. 1. Divide $\frac{1}{4}$ by $\frac{2}{3}$ $\frac{2}{3})\frac{1}{4}(\frac{1}{8}$ or $1.\frac{2}{8}$.

Quest. 2. Let $\frac{1}{8}$ be divided by $\frac{2}{7}$ $\frac{2}{7})\frac{1}{8}(\frac{1}{16}$ or $2.\frac{1}{16}$.

Quest. 3. Divide 42 by $7.\frac{1}{2}$, that is divide 42 by $7.\frac{1}{2}$ $7.\frac{1}{2})42(\frac{42}{1}$ or $5.\frac{1}{3}$.

Quest. 4. In like Manner if $6.\frac{1}{2}$ be divided by $3.\frac{2}{3}$, the Quotient will be $1.\frac{1}{4}$.

$1.\frac{1}{3})1.\frac{1}{2}(\frac{1}{3}\frac{1}{4}$ or $1.\frac{1}{3}\frac{1}{4}$.

Quest. 5. Also if $5.\frac{1}{3}$ be divided by $12.\frac{1}{2}$, the Quotient will be $\frac{1}{7}\frac{1}{3}$.

Quest. 6.

262 Questions in Vulgar Fractions.

Quest. 6. If 12 be divided by $\frac{2}{3}$ and $\frac{1}{8}$, the Quotient will be 24.

$$\begin{array}{r} \text{Add } \frac{2}{3} \quad \frac{1}{8} \\ \hline 20 \\ 5 \\ \hline 25 \end{array} \quad \begin{array}{r} 10 \\ 5 \\ \hline 50 \end{array}$$

$\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$ $\frac{2}{3} \times \frac{1}{4} = \frac{1}{6}$ $\frac{1}{6} + \frac{1}{8} = \frac{4}{24} + \frac{3}{24} = \frac{7}{24}$ $\frac{12}{1} \div \frac{7}{24} = 12 \times \frac{24}{7} = \frac{288}{7} = 41 \frac{1}{7}$

Facit $\frac{2}{3} \div \frac{1}{8} = \frac{2}{3} \times 8 = \frac{16}{3} = 5 \frac{1}{3}$

Quest. 7. I demand the Quotient of $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$, divided by $\frac{2}{3}$ of $\frac{1}{2}$.

Thus $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ *Facit* $\frac{1}{4}$ or $\frac{1}{4}$.

And $\frac{2}{3}$ of $\frac{1}{2}$ makes $\frac{1}{3}$ or $\frac{1}{3}$.

Thus $\frac{1}{4} \div \frac{1}{3} = \frac{3}{4}$ for Answer.

Questions to exercise the Rules of Vulgar Fractions before delivered.

Question the first.

The Difference of two Numbers is $1 \frac{1}{4}$, the lesser Number is $2 \frac{1}{8}$, what is the greater?

Answer $3 \frac{3}{8}$. found by Addition.

Thus add $\frac{1}{24}$ to $\frac{1}{8}$

$$\begin{array}{r} 704 \\ \hline 37 \text{ X } 17 \\ 24 \text{ X } 18 \\ \hline 192 \end{array}$$

(192)

Questions in Vulgar Fractions. 263

$$192)704(3. \frac{1}{3} \frac{2}{3} = \frac{2}{3}.$$

576

128

Abbreviation.

$$\frac{1}{3} \frac{2}{3} | \frac{6}{8} | \frac{1}{4} \frac{2}{8} | \frac{1}{2} \frac{4}{8} | \frac{1}{2} \frac{4}{8} | \frac{1}{2} \frac{4}{8}.$$

Quest. 2. What Number is that which if added to $3. \frac{2}{3}$ gives the Sum $8. \frac{2}{3}$.

Answer, $4. \frac{2}{3}$ by Subtraction.

Thus $8. \frac{2}{3}$ is $\frac{13}{3}$.

$$3. \frac{2}{3}$$

$\frac{2}{3}$ from $\frac{13}{3}$

$$\begin{array}{r} 2552 \\ \hline \end{array} \quad \begin{array}{r} 5816 \\ \hline \end{array}$$

$$\begin{array}{r} \frac{2}{3} \\ \hline \end{array} \quad \begin{array}{r} \frac{13}{3} \\ \hline \end{array}$$

704

5816

2552 subt.

3364 Rest

704)3264(4. $\frac{2}{3}$ for Answer.

Abbreviation.

$$\frac{4}{3} \frac{2}{3} | \frac{2}{3} \frac{2}{3} | \frac{1}{2} \frac{4}{8} | \frac{1}{2} \frac{4}{8} | \frac{1}{2} \frac{4}{8}.$$

There is in 3 Bags the Sum of $121. \frac{2}{3}$ Pounds, viz. in the first Bag $50. \frac{1}{3}$, in the second $40. \frac{1}{3}$, what is in the third Bag? Found by Addition and Subtraction.

Thus,

6075

4832

50. $\frac{1}{3}$

40. $\frac{1}{3}$

120

Add $\frac{607}{120}$ to $\frac{4832}{120}$.

S 4

120

264 Questions in Vulgar Fractions.

120) 10907 (90. $\frac{127}{20}$.

1080

107

6075

4832 add

10907

Then take $\frac{27}{20}$. $\frac{127}{20}$ from $121. \frac{27}{20}$.

Thus

120

107 sub

1080

520 from $121. \frac{27}{20}$

40

13 mult.

120

40

520

4800

Then take 520 from 1080, rest $4\frac{160}{20}$.

$\frac{160}{20} | \frac{280}{20} | \frac{16}{20} | \frac{28}{20} | \frac{14}{20} | \frac{7}{20}$.

Then from $\frac{127}{20}$. $\frac{27}{20}$

Remains $30. \frac{2}{20}$.

Here you may observe, That by reason the fractional Part of the mixt Number to be subtracted, is greater than the fractional Part of the mixt Number, from which you are to subtract, as here $\frac{127}{20}$ is greater than $\frac{27}{20}$; then you must subtract the said greater Fraction from an Integer, borrowed from the greater mixt Number, as by the Rule before taught.

Quest.

Questions in Vulgar Fractions. 265

Quest. 4. Two Merchants *A.* and *B.* have certain Shares in a Ship, the Share of *A.* is $\frac{7}{8}$ of the Ship, that of *B.* $\frac{2}{13}$, what is the Difference between their Parts?

Answer, the Share of *A.* exceeds the Share of *B.* by $\frac{1}{130}$.

Thus found.

$$\begin{array}{r}
 \begin{array}{cc}
 \overset{21}{A} & \overset{22}{B} \\
 \hline
 \underset{10}{} & \underset{13}{}
 \end{array}
 \times
 \begin{array}{cc}
 \overset{22}{B} & \overset{21}{A} \\
 \hline
 \underset{13}{} & \underset{10}{}
 \end{array}
 \end{array}
 \begin{array}{r}
 \text{Take } 91 \\
 \hline
 90 \text{ sub.} \\
 \hline
 1
 \end{array}$$

$\frac{1}{130}$

What is $\frac{2}{3}$ of 130. $\frac{2}{3}$.

Answer, 81. $\frac{2}{3}$.

Found by Multiplication thus.

$\frac{2}{3}$ of $130\frac{2}{3}$ is $126\frac{2}{3}$

$$\begin{array}{r}
 24 \overline{) 1960(81\frac{2}{3}} \\
 \underline{192} \\
 40 \\
 \underline{24} \\
 16
 \end{array}$$

$\frac{1}{24} \overline{) 81\frac{2}{3}}$

Quest. 6. What Number is that, which being multiplied by $\frac{2}{3}$ produceth 25. $\frac{2}{3}$.

Answer, 42. $\frac{1}{3}$.

Quest.

Found by Division thus,

Divide 25. $\frac{2}{3}$ by $\frac{1}{3}$.

$$\frac{2}{3}) \frac{122}{3} (\frac{61}{1} \frac{2}{3}$$

$$15)635(42.\frac{1}{3}$$

60

35

30

5

These Questions was desired to be worked:

The Rule of Three Direct in Fractions.

TO work this Rule you must multiply the Denominator of the first Number, by the Numerator of the second; then multiply that Product by the Numerator of the third Number, and reserve this Product for a new Numerator; that done multiply the Numerator of the first Number, by the Denominator of the second; also multiply this Product by the Denominator of the third, so shall this Product be a new Denominator. Lastly, this new Fraction so sought is the Answer to the Question, which said Fractions, whether proper, improper or mixt Fractions, may be reduced into its equivalent Fractions as before taught.

As

As for EXAMPLE.

If $\frac{1}{4}$ of a Yard cost $\frac{3}{8}$ of a Pound what will $\frac{7}{8}$ of a Yard?

$$\begin{array}{r} 5 \\ \hline 20 \\ 7 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ \hline 18 \\ 8 \\ \hline \end{array}$$

140 Numerator

144 Denom.

$$\frac{140}{144} \div \frac{3}{8} = \frac{140 \times 8}{144 \times 3} = \frac{1120}{432} = \frac{140}{54} = \frac{70}{27}$$

$$\frac{1}{4} \times \frac{3}{8} = \frac{3}{32}$$

Answer $\frac{140}{54}$ or $\frac{70}{27}$.

Which said $\frac{70}{27}$ being reduced into Shillings, Pence, and Farthings makes 19 s. 5 d. $\frac{1}{4}$.

Quest. 2. If $\frac{1}{4}$ of a Pound of Cinnamon be sold for 1 s. $\frac{1}{2}$ what cost $\frac{1}{2}$ lb.

$$\begin{array}{r} 1 \\ \hline 9 \\ \hline 36 \\ \hline 1 \\ \hline \end{array}$$

36 Num.

$$\begin{array}{r} \text{Thus } 3 \\ \hline 8 \\ \hline 24 \\ 2 \\ \hline 48 \\ \hline \end{array}$$

Answer, $\frac{1}{4}$ l. = 9 d.

$\frac{140}{54} \div \frac{1}{4} = \frac{140 \times 4}{54} = \frac{560}{54} = \frac{280}{27}$ of a Pound Sterling, which is 9 d.

Quest. 3.

Quest. 3. If $\frac{1}{4}$ of a Yard cost $\frac{3}{4}$ of a Pound Sterling, what cost $\frac{1}{2}$ of a Yard.

Yard	lb	Yard.
$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{2}$
4	3	Answer $\frac{10}{27} = 7s. 4d. \frac{1}{2}$
16	27	
5	8	

80 Num. 216 Denom.

$$\frac{80}{216} \mid \frac{40}{108} \mid \frac{20}{54} \mid \frac{10}{27}$$

Quest. 4. If $\frac{2}{3}$ of a Pound buy $\frac{1}{2}$ Yards of Cloth, what will $\frac{1}{2}$ of a Yard cost at that Rate?

Stated thus :

Yard	l.	Yard
$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{2}$
2	5	
12	15	Answer $\frac{11}{15} = 14s. 8$
11	12	

132 Num. 180 Denom.

$$\text{Answer } \frac{11}{15} = 14s. 8$$

Quest. 5. If 3 Yards of broad Cloth cost 2 l. $\frac{4}{7}$, what will 14. $\frac{2}{7}$ Yards cost?

Yard	l.	Yards
$\frac{3}{1}$	$2\frac{4}{7}$	$14\frac{2}{7}$ cost.
3	101	
5	14	
15	404	
7	101	
105	1414	

$\frac{105}{1414}$ of a Pound, equal
to 13 l. 9 s. 4 d.

Thus

Thus proved, by reducing your Fractions as before taught.

$$105)1414(13 \text{ l. } 9 \text{ s. } 4 \text{ d.}$$

$$\underline{105}$$

$$364$$

$$\underline{315}$$

$$49$$

$$\underline{20}$$

$$105)980(9 \text{ s.}$$

$$\underline{945}$$

$$35$$

$$\underline{12}$$

$$105)420(4 \text{ d.}$$

$$\underline{420}$$

$$0$$

Thus you see as by the Operation, that $\frac{10}{14} \frac{1}{14}$ equal to 13 l. 9 s. 4 d.

Quest. 6. if 1 l. of Cochineal cost 25 s. what will 36 l. $\frac{1}{10}$ of Cochineal.

$$\frac{11}{2} \quad \frac{1}{10} \quad \frac{11}{2}$$

$$\frac{1}{10}$$

$$367$$

$$\underline{25}$$

$$1835$$

$$\underline{734}$$

$$9175$$

$$\frac{2111}{10} \frac{1133}{2} = 45 \text{ l. } 17 \text{ s. } 6 \text{ d.}$$

For,

Rule of Three

For,

$$2)1835(917 \text{ s.}$$

$$\frac{1}{2} 45|17:6 d.$$

Quest. 7. If 1 Yard cost 9 s. what cost 4 Yards $\frac{1}{2}$.

Answer, $26\frac{1}{2} = 43 \text{ s. } 6 d.$

$$\begin{array}{r}
 \frac{1}{2} \quad \frac{1}{2} \quad \frac{1}{2} \\
 \hline
 6 \quad 9 \quad 26\frac{1}{2} \\
 \hline
 6 \quad 26\frac{1}{2} \quad 26\frac{1}{2} \\
 \hline
 6)261(43 \text{ s. } \frac{1}{2} \\
 \underline{24} \\
 21 \\
 \underline{18} \\
 3
 \end{array}$$

Quest. 8. If a Quantity of Amber-grease weighing 1. $\frac{1}{2}$ lb Troy, be sold for 60 l. Sterling, what will 19 lb. $\frac{1}{4}$ Grains worth at that Rate?

$$\begin{array}{r}
 \text{lb.} \quad \quad \quad \text{l.} \quad \quad \quad \text{lb. gr.} \\
 1. \frac{1}{2} \quad \quad \quad 60 \quad \quad \quad 19. \frac{1}{4}
 \end{array}$$

Or reduced into improper Fractions.

$$\begin{array}{r}
 \text{lb.} \quad \quad \quad \text{l.} \quad \quad \quad \text{grs.} \\
 1\frac{1}{2} \quad \quad \quad 60 \quad \quad \quad 1\frac{1}{4}
 \end{array}$$

Note, The third Number must be reduced into a Fraction of a Pound Troy, thus $1\frac{1}{4}$ Grains are $\frac{1}{4}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of a Pound Troy, which compound Fraction being reduced into a single Fraction, will be

in Fractions.

271

be $\frac{1}{4}$ of $\frac{1}{2}$ Pounds Troy, and then the three Numbers are brought into a Rule.

Thus,

$\frac{1}{4}$	$\frac{1}{2}$	grains
12	60	157
7	1	46080
		12
	60	92160
	7	46080
	420	552960 Deno.
	157	
	2940	
	2100	
	420	
	65940 Num.	

$$\frac{1}{4} \times \frac{1}{2} \times \frac{1}{4} = 2 \text{ s. } 4 \text{ d. } - \frac{1}{192}$$

Quest. 9. When the $\frac{1}{4}$ of $\frac{1}{4}$ of a Ship is valued at 147 l. 11 s. 3 d. how much is the whole Ship worth?

By converting the 147 l. 11 s. 3 d. into Pence, the three Numbers will stand thus:

Ship	Pence	Ship
If $\frac{1}{4}$	35415	$\frac{1}{4}$
	10	
	354150	
	—	l. s. d.
	Answer, 3	= 491 : 17 : 6
		3)354150

Rule of Three

3)354150(118050(983|7
..... 108..... d.

$$\frac{100}{96} = \frac{45}{36}$$

$$\frac{100}{96} = \frac{45}{36}$$

$$\frac{100}{96} = \frac{45}{36}$$

$$\frac{100}{96} = \frac{45}{36}$$

$$\frac{100}{96} = \frac{45}{36}$$

$$\frac{100}{96} = \frac{45}{36}$$

Quest. 10. If 3 Yards of broad Cloth cost 2 l. 3 s. 4 d. what will 14. $\frac{1}{2}$ of Yards?

$$\frac{3}{101} = \frac{672}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

$$\frac{672}{101} = \frac{3}{x}$$

2. $\frac{1}{2}$ is 56 Shillings, which is 672 Pence.

Answer, 13 l. 9 s. 4 d.

The Inverse, or Backward Rule of Three in Fractions.

AFTER a Question belonging to this Rule is duly stated and prepared, the Operation or Rule will be thus:

The RULE.

Multiply the Denominator of the third Fraction, by the Numerator of the second. Also multiply that Product by the Numerator of the first Fraction, and reserve the Product for a new Numerator.

Again, multiply the Numerator of the third Fraction by the Denominator of the second; also multiply this Product by the Denominator of the first Fraction, so is the last Product a new Denominator, so this new Fraction is the fourth Number sought.

As for EXAMPLE.

Quest. 1. If $\frac{1}{4}$ of a Yard of Cloth that is 2 Yards wide will make a Garment, how much of any other Drapery that is $\frac{1}{3}$ of a Yard wide will make the same Garment.

	Yards	
$\frac{1}{4}$	$\frac{2}{1}$	$\frac{1}{3}$
5	3	
2	1	
10	3	
3	4	

Answer 2. $\frac{1}{2}$ Yards.

$\frac{10}{12}$ Answer.

Facit 2 Yards $\frac{1}{2}$.

(805830 Num. 12 Denom. T

Quest.

274 Rule of Three Indirect

Quest. 2. Suppose when Wheat is at 40 s. and 6 d. a Quarter, the Penny Wheat-Loaf ought to weigh 8 Ounces and 1. $\frac{4}{9}$, Penny-weight Troy, what ought it to weigh, when Wheat is at 36 Shillings a Quarter?

s.	d.	oz.	pwt.	s.
40	6	8	1	36
12		20		12
486		161		432
		19		
		1454		
		161		
		3064		

Then according to Rule.

3064	19
486	1
18384	19
24513	432
12256	38
1489104	57
	76
	8208
	Divisor.

(8208)

in Fractions.

275

20 Ounces.

8208)1489104(181(9 : 1 Pennyweight 10 Grains, $\frac{1}{3}$.

8208 180

66830 1

65664

11664

8208

3456

oz. pwt. grs.
Answer, 9 : 1 : 10 = $\frac{1}{3}$.

Quest. 3. If $\frac{3}{8}$ of a Yard of Cloth in Length, and 1 Yard $\frac{1}{4}$ Broad, make a Child's Coat, how much Stuff will make the Child a Coat, when the Stuff is but $\frac{1}{2}$ of a Yard Broad.

$\frac{3}{8}$ ——— $\frac{1}{4}$ ——— $\frac{1}{2}$

3
6

18

4

72 Denom.

4

5

20

7

140 Num.

72)140(1. $\frac{1}{18}$ or 3 qrs. 3 nails. $\frac{1}{9}$.

72

68

1d qrs. nails.

Answer, 1 : 3 : 3 = $\frac{1}{9}$!

$\frac{5}{7} \frac{2}{3} \frac{1}{6} \frac{1}{8}$

T 2

Quest.

Quest. 4. If of Cloth which is 1 Yard $\frac{1}{4}$ Broad, and 3 Yards $\frac{1}{2}$ in Length, will make a Cloak, how much in Length of that Cloth, which is $\frac{5}{8}$ Yards in Breadth will make a Cloak of the same Bigness with the former?

Breadth	Length	Breadth
$\frac{1}{4}$	$\frac{1}{2}$	$\frac{5}{8}$
	4	
	—	7
	8	7
	—	—
	40	49
Divisor		8

392 Dividend.

40)392(9 : $\frac{4}{5}$ or 3 : $\frac{1}{5}$.

360

32

$\frac{4}{40} | \frac{1}{20} | \frac{3}{10} | \frac{4}{5}$.

Yards grs.

Answer, 9 : 3 : $\frac{1}{5}$.



C H A P.

C H A P. XXIV.

*Of the Reduction of Vulgar Fractions
into Decimals.*

1. **T**HE Arithmetick of whole Numbers, and broken Numbers commonly called *Vulgar Fractions*, I have with much Perspicuity, Plainness and Demonstration fully explained. Come we now to that excellent Invention of *Decimal Arithmetick*, of which, who was the first that brought it to Light, is hard to determine. But the great Improvement it hath arriv'd to within these few Years, comes now to be fully known.

2. The Use of it is best known to those, who can apply it to the practical Use of the *Mathematicks*, and for the computing of *Compound Interest*.

3. A *Decimal Fraction* is such a one, whose Denominator is understood, and therefore need not be expressed, by Reason that the *Decimal Parts* are only separated and known from whole Numbers by a Point or Comma, and take their Distance below the Units, towards the Right-hand; for as whole Numbers do increase the Value towards the Left-hand, by the like Proportion, as you may see in the Following Table

T 3

The

The TABLE.

Whole Numbers.	Decimal Parts.
0 Units Place,	6 Parts of 1000000
1 Tens,	5 Parts of 100000
2 Hundreds,	4 Parts of 10000
3 Thousands,	3 Parts of 1000
4 Tens of Thousands,	2 Parts of a Hundred
5 Hundreds of Thousands,	1 Parts of Ten or $\frac{1}{10}$

4. From this Table it does plainly appear, That as whole Numbers do increase or become greater from the Units Place towards the Left-hand, by a ten-fold Proportion; so Decimal Parts do decrease or become less from the Units Place towards the Right-hand in the same Proportion, viz. by Tens.

5. *Decimal Arithmetick* and its Parts are written in one Line, and are distinguished by prefixing a Comma, or Point before (to wit on the Left-hand) so $\frac{1}{10}$ may be written thus, .5 or ,5, and $\frac{1}{100}$ and $\frac{1}{1000}$ thus .0056. And as in Integers, every Degree from the Unit is increased toward the Left-hand, so in Decimal Parts, every Degree is diminished toward the Right-hand.

6. A Decimal Fraction of Coin may be easily valued without the Help of Tables; for each Unit in the

Decimal Fractions.

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the first Place is valued at 2 times the Figure in Shillings, the Figure 5, in the second Place 1 s. and the rest Farthings. Lastly, when 5 is taken from the Figure in the second Place, if every Unit in the Remainder be accounted as ten, and the Figure in the Remainder be accounted as ten, and the Figure in the third Place as Unities, these Tens, and Unities taken as one Number, and lessened by 1 give the Number of Farthings.

So .854 is in Value 17 : 1.

.418 is in Value 8 : 4.

So .8687 is 17 : 4 : $\frac{1}{4}$
 .319 is 6 : 4 : $\frac{1}{2}$

So .374 is 7 : 5
 .7960 is 15 : 11

Thus proved,

86872

20 multiply

17 | 3740
 12

4 | 4880
 4

1 | 9520

T 4

The

the first Place is valued at a times the Figure in Shil-

ling, which is taken from the

Figure in the second Place, if every Unit in the

Remainder be accounted as ten, and the Figure

the Remainder be accounted as ten, and the Figure

The TABLE of Reduction.

Of English Mo- ney, the Inte- ger being a Pound Sterling; Table the first.		Pence with Far- things.		
Shil- lings.	Decimals of a Pound.			
19.	95	0489583		01979161
18.	9	0479166	4.	01875
17.	85	046875		0177708
16.	8	0458333		0166666
15.	75	0447916		015625
14.	7	04375		0145833
13.	65	0427082		0135416
12.	6	0416666		0125
11.	55	040625		0114583
10.	5	0395833		4104166
9.	45	0385416		009375
8.	4	0375		0083333
7.	35	0364583		0072916
6.	3	0354166		00625
5.	25	034375		0052083
4.	2	0333333		0041666
3.	15	0322916		003125
2.	1	03125		0020833
1.	05	0302083		0010416
		0291666		
		028125		
		0270833		
		3260416		
		025		
		0239583		
		0229166		
		021875		
		0208333		

Of the Reduction
of Inches, &c. un-
to Decimals, the
Integer being a
Foot in length.

Of Time, a
Day being the
Integer.

The Table of
TIME con-
tinued.

Inches.	Decimals of a Foot.	Hours.	Decimals of a Day.	Minutes.	Decimals of a Day.
11.	9166666	23.	9583333	59.	0409722
10.	8333333	22.	9166666	58.	0402777
9.	75	21.	875	57.	0395833
8.	6666666	20.	8333333	56.	0388888
7.	5833333	19.	7916666	55.	0381944
6.	5	18.	75	54.	0375
5.	4166666	17.	7083333	53.	0368055
4.	3333333	16.	6666666	52.	0361111
3.	25	15.	625	51.	0354166
2.	1666666	14.	5833333	50.	0347222
1.	0833333	13.	5416666	49.	0340277
		12.	5	48.	0333333
		11.	4583333	47.	0326388
		10.	4166666	46.	0319444
		9.	375	45.	0312500
		8.	3333333	44.	0305555
		7.	2916666	43.	0298611
		6.	25	42.	0291666
		5.	2083333	41.	0284722
		4.	1666666	40.	0277777
		3.	125	39.	0270833
		2.	0833333		
		1.	0416666		

Quar-
ters of
an Inch.

Decimals of
a Foot.

3. 0625
2. 0416666
1. 0208333
0.104166

Of Liquid-Measures the Integer being a Gallon.		Table of Dry-Measure continu'd	
Pints.	Decimals of a Gallon.	Quar- ters of a Peck.	Decimals of a Quarter.
38. 0263888			
37. 0256944			
36. 0249999			
35. 0243055			
34. 0236111			
33. 0229166	7. 875	3. 0234375	
32. 0222222	6. 75	2. 015625	
31. 0215277	5. 625	1. 0078125	
30. 0208333	4. 5		
29. 0201388	3. 375	Pints.	Decimals of a Quarter.
28. 0194444	2. 25		
27. 01875	1. 125		
26. 0180555			
25. 0173611	Quar- ters of a Pint.	Decimals of a Gallon.	
24. 0166666			
23. 0159722			
22. 0152777	3. 09375	Of Long Measures, one Yard or one Ell, being the Integer.	
21. 0145833	2. 0625		
20. 0138888	1. 03125		
19. 0131944		Quar- ters of 1 Yard or 1 Ell.	Decimals of 1 Yard or 1 Ell.
18. 0125			
17. 0118055			
16. 0111111			
15. 0104166	Bushel.	Decimals of a Quarter.	
14. 0097222			
13. 0090277	7. 875		
12. 0083333	6. 75		
11. 0076388	5. 625		
10. 0069444	4. 5		
9. 00625	3. 375		
8. 0034722	2. 25		
7. 0048611	1. 125		
6. 0041666		Pecks.	Decimals of a Quarter.
5. 0034722			
4. 0027777	3. 09375	Quar- ters of 1 Nail.	Decimals of 1 Yard or 1 Ell.
3. 0020833	2. 0625		
2. 0013888	1. 03125		
1. 0006944			

Decimal Fractions.

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To Reduce Vulgar Fractions into Decimals, add Cyphers at Pleasure to the Numerator, and divide by the Denominator.

So $\frac{5}{8}$ being propounded to be reduced to a Decimal, will be changed into .625, that is $\frac{5000}{8000}$ for annexing Cyphers unto the Numerator 5, it will be 5000, which being divided by the Denominator 8, the Quotient will be 625, before which, prefixing a Point it will be .625 that is $\frac{625}{1000}$ the Decimal sought, as you may see in the Margin.

$$\begin{array}{r} 8 \overline{) 5000} \\ \underline{48 } \\ 20 \end{array}$$

Also $\frac{1}{4}$ will be reduced into the Decimal .25 (or $\frac{25}{100}$.)

$$\begin{array}{r} 4 \overline{) 100} \\ \underline{80 } \\ 20 \end{array}$$

Reduce $\frac{3}{5}$ into a Decimal Fraction.

$$5 \overline{) 4000} \text{ Facit .800 or } \frac{800}{1000}$$

Having before in the sixth Paragraph shewn in a brief Way, the discovering of a Pound Sterling in 0 Pounds, Shillings, Pence, and Farthings.

I proceed to shew you to reduce the Decimal of a Pound Troy-weight, viz. .86462 l. into known Parts, first, I multiply it by 12, because 12 Ounces is a Pound, and then by 20, because 20 Penny-weight is an Ounce, and then by 24, because 24 Grains makes 1 Penny-weight; and when you have so done, by cutting off the two first Figures of the Left-hand, I find the Value of the given Decimal .86462 Pounds Troy-weight to be as in the Margin.

So

So 86462

12

10 | 37544

20

07 | 50880

24

203520

101760

12 | 21120

So that I conclude the Value of the given Decimal 86462 Pound Troy-weight to be 10 oz. 7 Penny-weight, 12 Grains, 21 1/20. The same is to be observed in finding the Value of any other Decimal whatsoever, whether of Coin, Weight, Measure or Time.

I might here have added several Tables of *Reduction*, shewing the Decimal Parts of any Parts of Money, Weight, Measure, or Time, as divers Authors have done; but because tho' they are thus useful, yet they are seldom made use of, by Reason of the Ease in finding the Equivalent Decimal of any Fraction whatsoever, I shall forbear the making them, but proceed to the Uses of *Addition*, *Subtraction*, *Multiplication*, and *Division* in *Decimals*, which will be as easy as the Operations in whole Numbers.

Addition of Decimal Fractions.

AS for the Operations of *Addition* and *Subtraction*, they are the same as in whole Numbers; there must only care be had of setting Units under Units, and Fractions under Fractions, in their proper Ranks and Files, as likewise, that there be as many Places of *Fractions* in the Total, as are found in either of the *Sum* as before they are added together.

As

As for *EXAMPLE.*

$$\begin{array}{r} \text{To } 375 : 42 \\ \text{Add } 495 : 4 \\ \hline \end{array}$$

$$\text{Sum } 870 : 82$$

$$\begin{array}{r} \text{To } 375 : 42 \\ \text{Add } 95 : 03 \\ \hline \end{array}$$

$$\text{Sum } 470 : 45$$

If these mixt Numbers, to wit 32 .056, 7 .07, and 1 .9 were given to be added, they must be done, thus ranked,

32 .056	.85	24 .7	503 .75
7 .07	.025	0 .35	0 .32
1 .9	.03	5 .26	0 .12
41 .026	.705	30 .31	504 .19

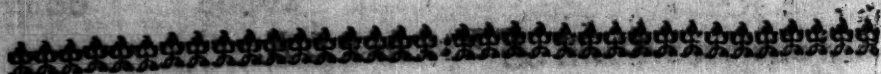
Places towards the Right-hand, supply that Defect by annexing Cyphers, or least by dropping Cyphers to be annexed to those Decimals.

Add

29 .93229	3
63 .55937	752
129 .20201	.098
3 .39371	.05
	.926
226 .08745	.83
	2 .956

Here you may observe, That the Number of Tens (if there be any contained in the first Place of the Decimals, being that next unto the Points) is the Number of Integers to be carried to the Place of Units or Integers.

Subtra-



Subtraction of Decimals.

BE sure to place the *Decimals* as is directed in the last Chapter, and then you may proceed, as you are taught in *Subtraction* of whole Numbers.

Examples hereof are these that follow,

$$\begin{array}{r} \text{From } 872.82 \\ \text{Take } 495.4 \\ \hline \text{Rest } 377.42 \end{array}$$

$$\begin{array}{r} \text{From } 470.45 \\ \text{Take } 95.03 \\ \hline 375.42 \end{array}$$

But here when the *Decimals* consist not of equal Places towards the Right-hand, supply that Defect by annexing Cyphers, or at least by supposing Cyphers to be annexed to those *Decimals*:

As for EXAMPLE.

$$\begin{array}{r} 24.04338 \\ .65 \\ \hline 23.39338 \end{array} \quad \begin{array}{r} 37. \\ 0.104 \\ \hline 36.104 \end{array} \quad \begin{array}{r} .394 \\ .35 \\ \hline .044 \end{array} \quad \begin{array}{r} .65 \\ .04338 \\ \hline .60662 \end{array}$$

How you may observe, That the Number of Ciphers (if there be any contained in the first Place of the Decimals, being that next unto the Point) is the Number of Figures to be carried to the Place

Multi



Multiplication of Decimal Fractions.

The RULE.

SO often as two Numbers are given to be multiplied, and are both mixt Numbers, or both *Decimal Fractions*, or one of them a whole Number, and the other a *Decimal* or mixt Number, write them down exactly one under the other, as is done in *Multiplication* of whole Numbers; and when you have gotten the Product, see how many Places of Fractions are found both in the Multiplicand and Multiplier jointly, just so many Places you must cut off from the Product, by a Point, Comma, or Line towards the Right-hand, as there are Places of *Decimals* in both the Multiplier and Multiplier.

As for EXAMPLE.

$$\begin{array}{r}
 \text{Multiply } 246.25 \\
 \text{By } 35 \\
 \hline
 123125 \\
 73875 \\
 \hline
 8618.75
 \end{array}
 \qquad
 \begin{array}{r}
 .87 \\
 .9 \\
 \hline
 .783
 \end{array}$$

Multiply

Multiplication of

$$\begin{array}{r} \text{Multiply } 342.34 \\ \text{By } 3.123 \\ \hline \end{array}$$

$$\begin{array}{r} 102702 \\ 68468 \\ 34234 \\ 102702 \\ \hline 10691.2782 \end{array}$$

$$\begin{array}{r} .2342 \\ .32 \\ \hline 4684 \\ 7026 \\ \hline 7.4944 \end{array}$$

Product 10691.2782

When the *Multiplication* is finished, if there arise not so many Places in all, as ought to be cut off, (which may often happen, when the Product is a Fraction ;) in such Case, as many Places as are wanting, so many Cyphers must be prefixed to the Product on the Left-hand thereof, to complete the Product.

As in these Examples.

Multiply .0375 by .05

$$\begin{array}{r} .0375 \\ .05 \\ \hline 1875 \end{array}$$

Now here being but four Figures, I prefix two Cyphers to complete the Product, so that the true Product of

Multiply .0375 is .001875 Product.
By .05

Product is .001875 as by the Rule

In like Manner, multiply this mixt Number
5.525 by .0026.

Thus,

5.525

.0026

33150

11050

.0143650 Product



Division of Decimal Fractions.

IN *Division of Decimals*, the greatest Difficulty is to know, of what Nature the first Figure or Cypher in the Quotient ought to be; for that being known, all other Operations are the very same, as in the ordinary Way in the working *Division* in whole Numbers.

N. B. Therefore, I shall give this general Rule for the finding of what Question soever, as shall be set in any of the Kinds whatsoever, therefore mark diligently the Rule.

For *Decimal Parts* there must be as many Places in the Divisor and Quotient, as are in the Dividend.

To illustrate this Rule, I shall give Examples in all the Cases.

U

First

First, Let 7.4944 be given to be divided by 32.

The Work stands thus :

$$32 \overline{) 7.4944} (.2343$$

64

109

96

134

128

64

64

0

Now according to the Rule, by Reason there are four *Decimal Parts* in the Dividend, there must be as many Places in the Divisor and Quotient, therefore the Point falls before .2342 on your Left-hand

Examp. 2. Suppose this mixt Number 9746.2 be divided by 32.4, the work will stand thus:

$$32.4 \overline{) 9746.2} (3.00$$

972

262

The *Division* being done as in whole Numbers, at length these Figures will arise in the Quotient, to wit 3.00, and according to your Rule, I find that the Figure stands in the Unit's Place, and the Quotient is at length discovered to be as afore-written.

Examp.

Examp. 3. Divide 48 by 43796, Now you perceive the Dividend 48, cannot be divided by 4376 you must therefore increase your Dividend with Cyphers at Pleasure after this Manner 48.000000, and work as in whole Numbers, before you can tell where the Units-Place will fall.

Thus.

$$\begin{array}{r}
 43796 \overline{) 48.000000} (1095 \\
 \underline{43796} \\
 420400 \\
 \underline{394164} \\
 262365 \\
 \underline{218980} \\
 43385
 \end{array}$$

Now to find out its true Value, consider that there are no *Decimal Places* in the Divisor, but there are Six in the Dividend; therefore there must be six *Decimal Places* in the Quotient (according to your Rule) therefore you must prefix on the Left-hand of your Quotient two Cyphers before the Figures 1095. So will the true Quotient appear to be thus.

$$43796 \overline{) 48.000000} (.001095 \text{ --- } \frac{1115}{43796})$$

This Case by being well observed, may perform all the Rules in *Decimal Fractions*; however for a farther understanding of this Rule, I will proceed with some more Examples through all Cases.

Examp. 4. Divide 172.5 by 3.746.

Thus,

$$3.746 \overline{) 172.500000} (46.049$$

$$14984 \dots$$

$$\underline{22660}$$

$$\underline{22476}$$

$$\underline{18400}$$

$$\underline{14984}$$

$$\underline{34160}$$

$$\underline{33714}$$

$$\underline{446}$$

Now it remaineth to separate the Integers in this Quotient from the *Decimal* Parts, which by the due Observation of your Rule aforegoing, you will find that there are 3 *Decimal* Places in the Divisor, and 6 *Decimal* Places in the Dividend, the Excess being 3, and consequently 3 *Decimal* Places noted in the Quotient. So

$$3.746 \overline{) 172.50000} (46.049 - \frac{446}{3746}.$$

is the Quotient, and 446 remaineth, which is less in value than $\frac{1}{1000}$ Part of an Unit or Integer.

Examp. 5. Suppose this mixt Number 2.34 given to be divided by this mixt Number 52.125. First, as before, annex Cyphers at Pleasure to the Dividend, at length these Figures will by the Operation arise.

52.125

$$\begin{array}{r}
 52.125 \overline{) 23400000 (.448} \\
 \underline{208500} \\
 255000 \\
 \underline{208500} \\
 465000 \\
 \underline{417000} \\
 48000 \\
 \underline{48000} \\
 0
 \end{array}$$

Thus by the Rule there are 3 *Decimals* in the Divisor, and 7 in the Dividend: there ought therefore to be 4 *Decimals* in the Quotient, which is to be done by putting a Cypher on the Left-hand.

Examp. 6. Divide .8564 by .008 by annexing Cyphers to the Dividend at Pleasure, the Quotient will be found to be.

Accordingly the true Quotient is found as above or 107. $\frac{1}{8}$.

Quest. 7. Divide this mixt Number .73952 by .32. Quotient is .32. 73952 (2.3 11 Answer

U3

Examp.

Examp. 8 Divide 14.070100 (by 3.2010.

3.2010) 14.070100 (4.39 for Answer.

128040

126610

96030

305800

288090

17710

17710

3.2010

Thus having according to the best of my Judgment, gone through all the necessary Cases that can happen in *Decimal Arithmetick* by *Division*, I shall go on with some few Examples in the Rule of Proportion, and in the Mensuration of some superficial Measures and Solids, before I come to shew more exactly their Use in the more difficult Parts, in the Extraction of the Square and Cube Roots.

The Rule of Three in Decimal Fractions.

IN this Rule, the Operations are the same in all Respects, as in whole Numbers; only when you work in *Decimals*, respect must be had to the *Decimal Rules* before taught, more especially when you come to the Answer in your Quotient, by duly separating the *Decimals* from the *Integers*. A few Examples will make you understand the Rule.

As

in Decimal Fractions. 295

As for *EXAMPLE*,

Examp. 1. If 9 lb. $\frac{1}{4}$ of Coffee cost 3 l. 15 s. how much will 278 lb. $\frac{1}{2}$ of Coffee cost?

Note, When the fractional Parts of the Numbers in this Question are converted into *Decimals*, then they will stand thus.

lb of Coffee	l.	Coffee cost.
9.25	cost 3.75	Shill. what will 278.5 of
		3.75
		13925
		12495
		8355
		1044.375

$$\begin{array}{r}
 \text{l. s. d.} \\
 9.25 \overline{) 1044.375} \quad (112.9.50 = 1+ \\
 \underline{925} \\
 1193 \\
 \underline{625} \\
 2687 \\
 \underline{1850} \\
 8375 \\
 \underline{8325} \\
 50
 \end{array}$$

Thus have I performed the Operation at large, and the Answer is found 112 l. 9 s. 1 d. +

Examp. 2. If 19 Ounces, 3 Pennyweight, and 5 Grains of Gold, be worth 62 l. 10 s. 6 d. what is the Value of an Ounce?

Answer 3 l. 5 s. 3 d. very near.

The Terms being reduced into Decimals, (according as hath been taught before) the Question will stand thus:

lb. Troy	l. Sterl.	lb. Troy
1. 596701	62.525	.083333
		62.525
		416655
		166666
		416665
		166666
		499998
		5.210395825

1.596701)5.210395825(3.263 Ans. 3 l. 5 s. 3 d. fr.

4790103

4202928

3193402

10095262

9580206

5150565

4790103

360462

360462

1.596701

Examp.

in Decimal Fractions. 297

Examp: 3. If 9 C. of Sugar cost 25 l. 7 s. what will be the Price of 17 C. Weight of the same at that Rate?

Thus stand,

$$\begin{array}{r} 9 \text{ --- } 25.35 \text{ --- } 17 \end{array}$$

17745

Proposed

$$9)43095(47.883$$

70

For Answer,

63

47 l. 17 s. 8 d. fere.

79

72

30

27

3

Found out by the brief Way of finding the Value of a *Decimal Part* of a Pound Sterling.

How many Yards of Waincoat Cloth that Room Measured whole Length is 10 Feet, 3 Inches The Length 100 Feet, 3 inches?

The farther Use of Decimals in the Mensuration of Superficies and Solids.

Proposition I.

THERE is a Chamber, whose Floor is 22 Feet, 9 Inches long, and 9 Foot 6 Inches broad, what is the Content in Feet and Inches?

Decimally thus,

Length	Feet
$22\frac{9}{10}$	9.5
95	what is the Content.
11375	
20475	
216125	

Answer 216 Feet, and $\frac{1}{2}$ Part of an Inch.

Answer'd.

Answer'd by Vulgar Arithmetick.

Feet	Inches	Feet	Inches.
22	9	9	6
long by 9 : 6 broad.			
12		12	
53		114	
22			
273			
114			
1092			
273			
273			
Feet, $\frac{1}{8}$ Part of a Foot.			
144	31122	(216. $\frac{1}{8}$	
288			
232			
144			
882			
864			
18			

So that you see this Question, is answered both decimally and after the vulgar Way in Fractions : But how tedious a Work it is to answer it this vulgar Way, I leave it to the Understanding Reader to judge.

Proposition 2.

How many Yards of Wainscot doth that Room require, whose Heighth is 12 Foot, 3 Inches, and Compass 104 Feet, 6 Inches ?

Feet

Use of Decimals

Feet

3 in Decimals is .25

6 in Decimals is .5

Therefore multiply
By

$$\begin{array}{r} 104.5 \\ \times 12.25 \\ \hline 5225 \\ 2090 \\ 2090 \\ \hline 1280.125 \end{array}$$

In Feet 1280.125

To answer the Question in Yards,

Divide by 9)1280126(142.236

$$\begin{array}{r} 9 \overline{)1280126} \\ \underline{9} \\ 38 \\ \underline{36} \\ 20 \\ \underline{18} \\ 21 \\ \underline{18} \\ 32 \\ \underline{27} \\ 5 \end{array}$$

$$\begin{array}{r} 142.236 \\ \times 9 \\ \hline 1278 \\ 180 \\ 54 \\ \hline 1278 \\ 180 \\ 54 \\ \hline 1280.126 \end{array}$$

So that you see this Question is answered both
decimally and after the vulgar Way in Fractions:
But now tedious a Work it is to answer it this vulgar
Way, I leave it to the Understanding Reader to judge.

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Proposition 2.

How many Yards of Waincoat doth that Room

Answer, 142 Yards, 18 2/3 Feet; or 142 Yards,
2 Feet, 3 Inches.

Pro-

in Measuring.

303

Proposition 3.

How many Yards in a Ceiling 47.4 Inches long, and 18 Feet broad?

Decimally 8 Answer.

$$4 \text{ Inches} = 3333. \frac{1}{3}$$

Therefore multiply 47.3333

$$\begin{array}{r} 47.3333 \\ \times 18 \\ \hline 3786664 \\ 473333 \\ \hline 851.9994 \end{array}$$

Feet Inches
851 : $\frac{234}{1000}$

Into Yards Which being reduced give 8 Acres 2 Rods, and 27 Perches.

$$9) 851.9994 (94.6666$$

81 yds Feet in.

Answer, 94 : 6 : 10 : 6

$$\begin{array}{r} 41 \\ 36 \\ \hline 59 \\ 54 \\ \hline 59 \\ 54 \\ \hline 59 \\ 54 \\ \hline 54 \\ 54 \\ \hline 9 \end{array}$$

Pro-

Proposition 4

Perches

There is a square Piece of Land that is 37.25,
what is the Content in Acres, Roods and Perches?

Answer, 8 Acres, 2 Roods, and 27 Perches.

$$\begin{array}{r}
 37.25 \\
 37.25 \text{ Square} \\
 \hline
 18625 \\
 7450 \\
 26075 \\
 11175 \\
 \hline
 1387.5625 \text{ Square Perches.}
 \end{array}$$

Which being reduced will give 8 Acres, 2 Roods,
and 27 Perches.

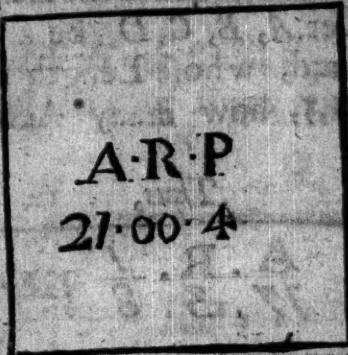
$$\begin{array}{r}
 40 \overline{) 1387.5625} \quad 4 \overline{) 34.6890} \quad (8 \text{ Acres, } 2 \text{ Roods, } 25 \text{ Perches.} \\
 \underline{120} \quad \underline{32} \quad \underline{32} \\
 187 \quad 2 \quad 02 \\
 \underline{160} \quad \underline{2} \quad \underline{02} \\
 275 \quad 14 \quad 02 \\
 \underline{240} \quad \underline{42} \quad \underline{02} \\
 356 \quad 27 \quad 02 \\
 \underline{320} \quad \underline{42} \quad \underline{02} \\
 362 \quad 12 \quad 02 \\
 \underline{360} \quad \underline{12} \quad \underline{02} \\
 25 \quad 02
 \end{array}$$

Propo-

Proposition 5.

A

C



To Measure a Square

B

D

58

58

—

464

290

— 4 A. R. P.

40)3364(84(21 : 0 : 4

320 8 :

— —

164 04

160 4

— —

4 0

— —

Multiply the Side by itself, viz. 58 by 58, Facit 3364 Poles, which reduce into Acres, by dividing them first by 40, to bring them into Roods, and then by 4 to bring them into Acres; so it is found 21 Acres, 00 Roods, 4 Perches.

Proposition

Proposition 6.

To measure a Long-Square the Length and Breadth being given. Let A, B, C, D , be a Long-square given to be measured, whose Length is 78.75 Perches, and Breadth 36.5, how many Acres, Roods, and Perches?

Thus,

$$\begin{array}{l} 36.5 \\ \hline \boxed{A. R. \frac{1}{8} \text{ perch}} \\ \hline \end{array}$$

78.75

Multiply the Length by the Breadth, so have you the Content in Perches or Poles, which divide again by 4 to bring into Acres.

Thus 78.75

36.5

39375

47250

23625

4

40) 2874.375 (71.859 (17.964

280 4

74

31

40

28

343

38

320

36

237

25

200

24

375

19

360

16

Acres Roods

Answer, 17 : 3 : 15 Perch.

15

3

Perch

Proposition 7. 8. Proposition 8.

To measure a Rhombus.

A Rhombus hath all its Sides equal, and opposite Angles equal, but none of them right.



Let BC be 48 Foot, and AD 41.5 Foot, to know the Content in Acres, Roods and Perches.

Thus,

Multiply the Side of the Rhombus BC , by the Perpendicular EB , and the Product sheweth the Content in Perches to be 1992, and in Acres, 12 Acres, 1 Rood, 32 Perches.

Thus found:

$$\begin{array}{r}
 48 \\
 41.5 \\
 \hline
 192 \\
 1968
 \end{array}$$

24 add for the Fraction $\frac{1}{4}$ or $\frac{1}{2}$ of 48.

40) 1992 (49 (12 Acres 1 : 32

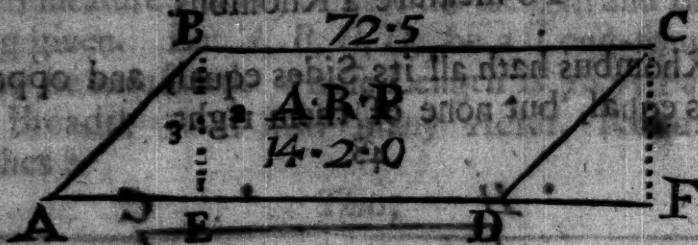
32

X

Pr 8

Proposition 8. Measuring a Rhomboides.

To measure a Rhomboides. A Rhomboides has all its Sides equal and opposite Angles equal, but none of them right Angles.



A Rhomboides is that whose opposite Sides are equal, as also the opposite Angles, but none of them right.

Multiply the Length BC 72.5 by the Perpendicular AE 14.2, and the Product sheweth the Product is 1028.5 Poles or Berches.

Let BC be 48 Foot, and AE be 8 Foot, and the Content in Acres, Roods and Perches.

Thus found,

Multiply the Side of the Rhomboid BC by the Perpendicular AE , and the Product sheweth the Content in Perches to be 1028.5, and in Acres, 12 A.

1028.5	
144	
612	
2304	
16	
4	A. R. P.
40)2320(58	14 : 2 : 0
200	
2	
320	

add for the Fraction of 1/2 of 48.

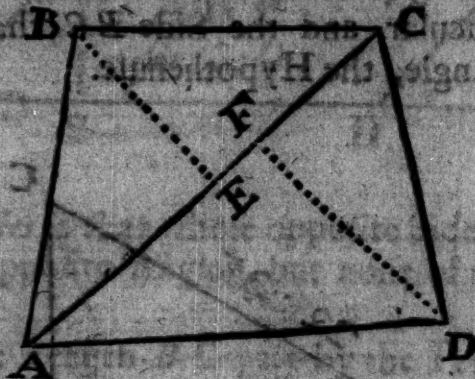
40)1028.5(25.7125

The Content is 14 Acres, 2 Roods.

Proposition

Proposition 10,

To find the Content of a Trapezium.



Let A, B, C, D . be a Trapezium given to find the Content.

Admit the Diagonal-line AC to be 9.5

The Perpendicular-line AE to be 3.45
 The other Perpendicular FD . 4.25 } ad

The Sum of the Perpendicular Lines are 7.70

Their half Sum 3.85

Which said 3.85 being to be multiplied by the Diagonal Line AC . 9.5 . Facit 36.575 is the full Content of the Trapezium required in Feet.

3.85 } multiply
 9.5

1925

3465

36.575 Product.

Proposition 11.

Proposition 11.

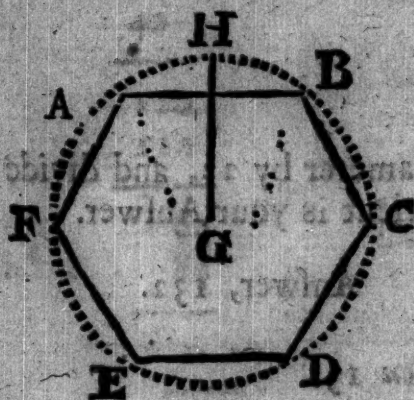
To find the Content of any regular Polygon.

DEFINITION.

A regular Polygon is a plain Figure consisting of five equal Sides, and is termed a *Pentagone*; if a Figure have 6 equal Sides, 'tis named a *Hexagon*, or Polygon of six equal Sides, if 7 a Polygon of seven equal Sides, if eight an *Octagon* of eight equal Sides!

And to measure any one of these regular Polygons do thus: Draw a Line from the Center of the Figure, to the middle of any one of the Sides, and multiply that Line into half the Sum of the Sides, and the Product is the Content of that Polygon.

Let there be given the Hexagon *ABCDEF*, having the Length of each Side 30, then will the length of the Perpendicular *G. H.* be 26 fere, now there being



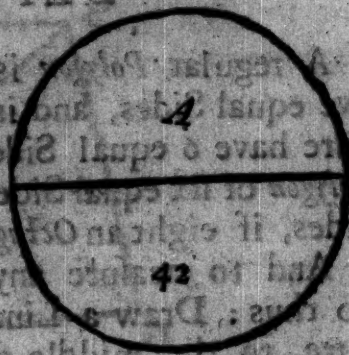
30	90
6	26
180	540
2)180(90	180
...	2340

in all 6 Sides, each of them in length 30, therefore 30 multiplied by 6 is 180, the half of which is 90, which being multiplied by 26 the Product will be 2340, which is the Content of the given Hexagon.

Proposition 12.

To find the Length of the Circumference of a Circle, the Diameter being known.

Let *A*. be a Circle whose Diameter is 42, what is the Length of the Circumference?



$$\begin{array}{r}
 42 \\
 \times 22 \\
 \hline
 84 \\
 840 \\
 \hline
 924
 \end{array}$$

Multiply always the Diameter by 22, and divide the Product by 7 your Quotient is your Answer.

Answer, 132.

Proposition 13.

The Circumference being given, to find the Diameter, as in the former Circle, the Circumference be 42, and the Diameter required.

Multiply the Circumference always by 7, and divide the Product by 22, and the Quotient is the Diameter.

Cir

in Measuring

Circumference 132

22) 924 (42 the Diameter required.
88

44
44

0

Proposition 14.

The Diameter of a Circle being given, to find the Area or Content thereof.



14) 19404 (1386 for Diameter, the 42
14 Content of the Cir- 42
cle required.

54
42

120
112

84
84

0

84 } multiply
168

1764
11

1764 } multiply
1764

19404

Multiply the Diameter by its self; again, multiply by 11, and divide by 14, and your Desire is found.

N. B. As for Solid-Measure, as Pyramids, Cones, and others, they shall be performed after the Square and Cube-Roots are learn'd.

C H A P. XXV.

The Extraction of the Square-Root.



THUS much for *Arithmetick* either in Integers, or Fractions both Vulgar and Decimal, proceed we now to the Extraction of Roots, *viz.* of the Square and Cube Roots.

2. The Extraction of the Square-Root, is that by which having a Number given, we find out another Number, which being multiplied by it self, produceth the Number given.

3. Square Numbers are either single or compound.

4. All the single Square Numbers, together with their respective Roots, are expressed in the Table here set down, *viz.*

Squares	1	4	9	16	25	36	49	64	81
Roots	1	2	3	4	5	6	7	8	9

When a Number is given that exceeds not 100, and yet is none of the Square Numbers mentioned in this Table, for his Root: You are then to take the Root of the Square Number, that being less yet comes nearest to it.

Extraction of, &c.

313

5. A Compound-Square Number is that which being produced by a Number, (that consists of more Places than one) multiplied by itself is never less than 100 ; so 576 is a Compound-Square Number, produced by the Multiplication of 24 multiplied into its self.

6. To prepare any Square-Number given for Extraction, put a Point over the first Place thereof on the Right-hand (being the Place of Units) then proceed towards the Left-hand, pass over the second Place, and put another Point over the third Place, also passing over the fifth and so forward, in such a Method, that between every two Points, which are next one to the other, one Place may be intermitted.

24

24

96

48

576

As for Example.

To know the Root of

576(24

Again, 3364(58 the Root.

4

25

44)176

108)864

176

864

0

0

So that the Square-Root of 576 is 24.

And the Square-Root of 3364 is 58.

So if the Square-Root of 576 be required, the first Point is to be placed over 6, and the second 5 as you see, and as many Points as are in this Manner placed, so many Figures the Root will consist of.

576

7 Having

7. Having thus prepared your Number, you may see it divided by the Points into several Squares; so in the last Example 5 is the first Square, and 76 the second.

8. Having drawn a Quotient, find the Root of the first Square, and write it down in the Quotient; so I find that 2 to be the Root of 5. I write 576(2 2 in the Quotient, and so the work will stand thus.

9. Subscribe the Square of the Figure so written in the Quotient, under the first Square of the Number given, as you see in the Margin.

10. Then subtract the Square of the Figure in the Quotient out of the first Square, and place the Remainder orderly underneath the Line, so the Square of 2 which is 4, being subtracted from 5, the Remainder is 1, as you may see in the Margin.

11. To the said Remainder 1, bring down the next Square 76, being placed next to the Remainder 1, there will be found this Number 176, which may be called the *Resolvend*.

12. Double the Root being the Number placed in the Quotient, and place the said Double on the Left-hand of your *Resolvend* like a Divisor, so the double of 2 is 4; so that the Work will stand as you see in the Margin.

13. Let the whole *Resolvend*, except the first Place thereof on the Right-hand, be always esteemed as a Dividend, then asking how oft the Divisor 4, is contained in the Dividend

the Square-Root.

315

17, the Answer is 4, wherefore I write 4 in the Quotient, and also after the Divisor 4, as you see in the Margin. So 44 multiplied by 4 the Product is 176, the Figures of the Square Number placed above it, the Remainder is 0: And thus the whole work being finished, the Square-Root of 576, the Number propounded is found to be 24

$$\begin{array}{r}
 576(24 \\
 \underline{4} \\
 44)176 \\
 \underline{176} \\
 0
 \end{array}$$

N. B. In the Extraction of the Square-Root you must heedfully take Notice; first that if the Product before mentioned is greater than the *Resolvend* placed above it, the Work is false, and then you must Reform it by placing a lesser Figure in the Quotient, as you do in ordinary Division.

Secondly, For every one of the particular Squares, (distinguished by Points) except the first Square on the Left-hand, a new *Resolvend* is to be set apart, by bringing down to the Remainder the other next particular Square; and as often as a new *Resolvend* is set apart, so often a new Divisor is to be found, by doubling all the Root in the Quotient, let them consist of never so many Figures.

Thirdly, for the better finding out of the first Figure in the Root, you are to take Notice, that it is but once used in the Extraction of the Root: But the Work of the second or last Rule is to be repeated, for the finding of every Place in the Root, except the first,

The

The well-minding, and duly practising these three Notes, will exceedingly help you in the Practice of the working the Square-Root; as in the following Examples will be seen.

EXAMPLE. 2.

Let it be required to extract the Square Root of

33016516(5746

25

107)801 *Resolvend*

749

1144) 5265

4576

11486) 68916 *Resolvend*,

68916

o

EXAMPLE 3.

Extract the Square Root of 8328996.

8328996(2886

4

48)432

384

568) 4889

4544

5766) 34596

34596

o

EX

EXAMPLE 4.

Extract the Square-Root of 43623.

$$\begin{array}{r}
 43623 \text{ (208. } \frac{417}{417} \text{)} \\
 \underline{4} \\
 408 03623 \\
 \underline{3264} \\
 359
 \end{array}$$

As for the Fraction annexed 359 is the Numerator thereof, and 417 the Denominator; the Reason is thus, for as 208 the Root to be doubled is 416, whereunto if you add an Unit (according to this Rule) the Sum is 417, and therefore the Number sought for in this Demand is 208. $\frac{417}{417}$ as you may see in the Example itself.

But for that you find, that the Root 208 to be less than 209, yet how much it is greater than the said 208, no Rules of Art hitherto known could exactly discover, although we may proceed infinitely near, as in the next Rule shall be made manifest.

As when the Work is finished there happens to be a Remainder of 359, by annexing a competent Number of Cyphers to the given Number 43623, and work in the same Manner, as if there were significant Figures in an Integer. See the Work.

4362

43623.000000(208.861

The Root.

408)03623

3264

4168) 35900

33344

41766) 255600

250596

417721) 500400

417721

82679

208.1608

So that according to the Rules foregoing, you shall find the Root thereof to be 208.861, which is equivalent to 208. $\frac{417}{1000}$, for the whole Parts are the same in both the Roots; and as for the broken Parts and $\frac{1608}{1000000}$ or .861 have the same Value, as is apparent by the Example premised.

As when the Work is finished there happens to be a Remainder of 379, by annexing a competent Number of Cyphers, so the given Number 43623, and work in the same Manner, as if there were significant Figures in an Integer. See the Work.

Again,

qual to the Number, whose Square-Root was required: So in the first Example 24 being multiplied by itself, produceth 576 the Number propounded. But when after Extraction is finished, there happeneth to be a Remainder, which must be taken in, as in the Manner of the proving *Division*, thus as in the fourth Example.

$$\begin{array}{r}
 208.861 \\
 \hline
 208 \\
 \hline
 1664 \\
 4160 \\
 \hline
 43264 \\
 359 \text{ Remainder added:} \\
 \hline
 43623
 \end{array}$$

To extract the Square-Root of a Fraction.

It is found in this Manner, *viz.* extract the Root of the Numerator, which shall be a new Numerator; also the Root of the Denominator is to be taken for a new Denominator; so the new Fraction, shall be the Square-Root of the Fraction first propounded: Thus the Square-Root of $\frac{2}{17}$ is $\frac{1}{4}$ also the Square-Root of $\frac{1}{16}$ is $\frac{1}{4}$ and of $\frac{1}{4}$ is $\frac{1}{2}$.

Again, extract the Square-Root of $\frac{4}{17}$ being abbreviated is $\frac{2}{9}$, the Root of this may be extracted, and is found to be $\frac{2}{3}$ equivalent unto $\frac{4}{17}$ each Term is incommensurable; but the said $\frac{4}{17}$ being reduced to its lowest Terms $\frac{4}{17}$, there will be found in each Term a commensurable Root, *viz.* the Square-Root of 4 is 2, and the Square-Root of 9 is 3, so is $\frac{2}{3}$ equivalent unto $\frac{4}{17}$.

When

When either the Numerator or Denominator of a Fraction hath not a perfect Square-Root, such Root may be expressed by prefixing this Character before it, viz. $\sqrt{\quad}$, or $\sqrt{q}$ before the Fraction given; so the Square-Root of $\frac{1}{2}$ is signified thus $\sqrt{\frac{1}{2}}$ because the Root of $\frac{1}{2}$ cannot be expressed by any true or rational Number whatsoever, yet it may be found very near, as in the next Rule.

To extract a Square-Root near of a mixt Number.

The Square-Root of a mixt Number commensurable to its Root, must first be reduced into an improper Fraction; so the Square-Root $34\frac{3}{4}$ will be found $5\frac{3}{8}$, viz. $34\frac{3}{4}$ being reduced into the improper Fraction $\frac{2209}{64}$, the Square-Root of the Numerator 2209 will be 47 for a new Numerator; also the Square-Root of the Denominator 64 is 8 for a new Denominator, so it is found $\frac{47}{8}$, which said improper Fraction is $5\frac{3}{8}$ the Square sought.

Here always Note, That you bring the fractional Part of the mixt Number into its least Terms, before any Extraction can be made.

Thus much for the Extraction of the Square-Root; proceed we now to the Extraction of the Cube-Root.

THE Extraction of the Cube-Root is that, by which having a Number given, we find another Number, which being first multiplied by itself, and then by the Product produceth the Number given.

In the Extraction of the Cube-Root, the Numbers propounded are always conceived to be a Cube-Number; that is, a certain Number of little Cubes;

com-

comprehended within one entire great Cube, and the Root or Number required is the Side of the Square, which constitutes that great Cube.

Definition of a Cube,

What a Cube is may be well conceived by a Dye, which indeed is a little Cube itself, wherefore if you place four Dice in a square Form, that is laying

two, and two in a Rank, you shall have

5 a Square containing four Dice, upon which

if you yet erect such another Square of Dice,

you shall have a great entire Cube compre-

hending 5 times 25, that is, 125 little Cubes.

And in this Case 125 is the Cube Number

propounded, and 5 the Root or Number re-

quired.

A Cube Number is either Single or Compound; the single Cube-Numbers together with their respective Roots are expressed in the Table following.

Cubes	1	8	27	64	125	216	343	512	729
Squares	1	4	9	16	25	36	49	64	81
Roots.	1	2	3	4	5	6	7	8	9

Here in the uppermost Rank are placed the single Cube Numbers of the particular Figures 1 2 3 4 5 6 7 8 9, in the next the Squares of those Figures, and in the lowest Rank the Figures themselves, being the respective Roots of the Cubes and Squares in the uppermost Ranks; and therefore the Cube-root of 125 being demanded, the Answer is 5, and the Cube-root of 512 being required, the Table will give you 8, and so of the rest.

A com-

the Cube-Root.

323

A compound Cube Number is that, which being produced by itself, is never less than 1000, so 405224 is a compound Cube Number, being produced by thus :

$$\begin{array}{r} 74 \\ 44 \\ \hline \end{array}$$

$$\begin{array}{r} 5476 \\ 74 \\ \hline \end{array}$$

$$296$$

$$21904$$

$$518$$

$$38332$$

The Square 5476

405224 Cube-Number:

To prepare a Cube Number for Extraction, put a Point over the first Place thereof, towards the Right-hand; (to wit the Place of Units) then passing over the second, and third Places, put another Point over the fourth, and passing over the fifth and sixth Places, put another Point over the seventh, and in that Order (two Places being intermitted) place as many Points as the Number given will admit; so 405224 being given, place the Points thus :

405224

Having thus prepared your Number, you may see it distributed by the Points into several Cubes; so in this Example 405 is the first Cube, and 224 the second.

Having drawn a crooked Line on the Right-hand of the Number propounded to signify a Quotient, find the Cube-root of the first Cube, and place it in the Quotient, so I finding 7 to be the correspondent Root of 405, I write 7 in the Quotient thus :

405224(7

Y 3

Then

Then subscribe the Cube of the Root placed in the Quotient thus.

$$405224(4$$

$$343$$

$$62$$

Draw a Line and subtract that Cube Number, and there remains 62.

To the said Remainder (*viz.* 62) bring down the next Cube of the Number propounded, *viz.* 224. being placed after the Remainder 62, there will be found this Number 62224, which may be called the *Resolvend*.

$$\text{Thus } 405224(7$$

$$343$$

$$62224 \text{ Resolvend.}$$

Having drawn a Line underneath the *Resolvend*, square the Root in the Quotient, that is, multiply it by it self, and subscribe the triple of the said Square or Product, under the *Resolvend* in such Manner, that the first Place (to wit the Place of Units) of the said triple Square 147 may stand directly under the third Place in the *Resolvend*; so the Square of the Root 7 is 49, the triple whereof is 147, which I subscribe under the *Resolvend* in such Manner, that the Figure 7 which is in the first Place in the triple Product, 147 may stand under as you see.

Triple

the Cube-Root.

325

7 Triple the Root or Number in the Quo-
 3 tient, viz. 7, which is 21, and subscribe
 this triple Number under the second in the
 21 *Resolvend.*

Then square the said Root, and then triple the
 said Square of the Root in its right Place, as you may
 see by the Work. Thus

405224(7

343

62224 *Resolvend.*

21 Triple Root

147

Triple Square of the Root.

} add

1491 Divisor.

Let the whole *Resolvend*, except the first Place
 thereof towards the Right-hand, be esteemed as a
 Dividend, then demanding how often the first Fi-
 gure (towards the Left-hand) of the Divisor is con-
 tained in the Dividend, write the Answer in the
 Quotient, which will be 4.

Having drawn another Line under the Work,
 multiply the Square before subscribed, by the Fi-
 gure last placed in the Quotient, and subscribe this
 Product under the said triple Square, so 147 being
 multiplied by 4, the Product is 588, which I sub-
 scribe thus as you see:

Y 3

405224(74

49522474
 343

62224 *Resolvend*

21 Triple Root
 147 Triple Square of the Root,

1491 Divisor,

588 Triple Square of the Root multiplied
 by 4.

4 Then you must next multiply the Figure
 4 last placed in the Quotient, first by it self,
 which is 16, and then the Product of 16
 16 by 21 the triple Root, so that 16 being
 21 multiplied by 21, the content is 336.

16 Lastly by squaring the last Figure 4,
 32 which makes 16, and multiplying again by
 4, makes the Cube of 4, 64.
 336

1491 Divisor
 4
 4 588 Triple Square of the Root
 336 Square of 4 multiplied by 21
 16 64 Cube of 4
 4
 62224 *Subtrahend*
 64

Which said *Subtrahend* being subtracted from the
Resolvend 62224 the Remainder is 0, thus the whole
 Operation being finished the Cube-root of 495224 is
 found to be 74.

the Cube-Root.

327

The whole Operation.

When the Sum of the three last before mentioned are greater than the Resolvend. Work is erroneous, which may be rectified by placing a lesser Figure in the Quotient.

405224(74
343
1491) 62224 Resolvend.
21 Triple Root } add, facit
147 Triple Square of the Root. } Divisor.
1491 Divisor.
588 Triple Square of 147 by 4.
336 Square of 4 multiplied by 21.
64 Cube of 4.
62224 Subtrahend.

(0)

Explanation 343 is the Root of 7.

7	147	4
3	4	4
21	588	16
7	4	4
7	4	64
49	16	
3	21	
147	16	
	32	
	336	

Note, the Learner ought to observe these three Things from the Rules before delivered, concerning the Extraction of the Cube-root.

Y 4

NOTE

NOTE the first.

When the Sum of the three last Numbers before-mentioned are greater than the *Resolvend*, the Work is erroneous, which may be reformed by placing a lesser Figure in the Quotient.

NOTE the second.

For every one of the particular Cubes (distinguished by Points) except the first Cube on the Left-hand, a *Resolvend* is to be set apart, by bringing them down to the Remainder of the next Cube. And as often as a *Resolvend* is set apart, so often is a new Divisor to be found, by adding the triple of all the Root in the Quotient, to the triple of the Square of such Root, after they are orderly placed.

NOTE the third, (o)

For the finding of the first Figure in the Root, it is but once used in the Extraction of the Root of any Number whatsoever; but the Work of all the preceding Rules beforementioned, is to be used for the finding of every Place in the Root, except the first.

The Practice of these three Notes, will be demonstrated in the following Examples,

Let

the Cube-Root.

329

Let it be required to extract the Cube-root of

$$\begin{array}{r}
 3 \quad 4862715(365 \\
 \underline{3} \quad 27 \\
 9 \quad \underline{\hspace{1cm}} \\
 279)21627 \\
 \underline{9} \quad \hspace{1cm} \\
 3 \quad 9 \text{ The triple Root.} \\
 \underline{27} \quad 27 \text{ The triple Square of the Root:} \\
 6 \quad 279 \text{ Divisor.} \\
 \underline{6} \quad \hspace{1cm} \\
 36 \quad 216 \text{ the Cube of 6} \\
 6 \quad 324 \text{ the Square of 6 in the triple Root.} \\
 \underline{216} \quad 162 \text{ the triple Square of the Root into 6.} \\
 \underline{\hspace{1cm}} \quad 19656 \text{ the Subtrahend.}
 \end{array}$$

$$\begin{array}{r}
 38988)1971125 \text{ Resolvend.} \\
 \underline{\hspace{1cm}} \quad \hspace{1cm} \\
 27 \quad 108 \text{ the triple Root of 36.} \\
 6 \quad 3888 \text{ the triple Square of the Root 36.} \\
 \underline{162} \quad \hspace{1cm} \\
 36 \quad 38988 \text{ Divisor.} \\
 \underline{3} \quad 125 \text{ the Cube of 5.} \\
 108 \quad 2700 \text{ the Square of 5 in the triple Root.} \\
 \underline{36} \quad 19440 \text{ the triple Square of the Root in 5.} \\
 \underline{36} \quad 1971125 \text{ the Subtrahend.} \\
 \underline{216} \quad \hspace{1cm} \\
 108 \quad 0 \\
 \underline{1296} \quad \hspace{1cm} \\
 3 \quad 5 \quad 108 \quad 3888 \\
 \underline{3} \quad 5 \quad 25 \quad 5 \\
 3888 \quad 25 \quad 540 \quad 19440 \\
 \underline{\hspace{1cm}} \quad 5 \quad 216 \quad \hspace{1cm} \\
 125 \quad 2700 \quad \hspace{1cm}
 \end{array}$$

EX-

EXAMPLE 3.

Let it be demanded to extract the Cube-root of

$$\begin{array}{r} 8302348(202+ \\ 8 \end{array}$$

126)0302 *Resolvend.*

12

06

126 Divisor.

12060)302348 *Resolvend.*

1200

60

12060 Divisor.

2400

240

88

242408 *Subtrahend.*

59940

Now if 242408 the *Subtrahend* is subtracted from the *Resolvend* 302348, there remains 59940.

I conclude, that the Cube-root sought is greater than the said 202, but less than 203; yet how much it is greater than 202, no Rules of Art hitherto known will exactly discover, although we may proceed infinitely near, as by the next Rule will be made manifest.

Add

the Cube-Root.

331

Add Ternaries of Cyphers, to wit 000, or 000000, or 000000000, then work as in the preceeding Rules.

8	302	348	000
8			
0	302		
1	2		
	06		
	26		
	302	348	
	120	0	
		60	
	120	60	
	240	0	
	2	40	
		08	
	242	408	
	59	940	000
	12	241	2
		6	06
	12	247	26
	48	964	8
		96	96
			64
	49	061	824
	10	878	176
	1	228	972
			60
	1	229	033
	9	831	782
		3	886
	9	835	668
	1	042	507

So that you shall find the Cube sought to be 202.48 that is $\frac{48}{1000}$ and more, wherefore you may conclude, that 202. $\frac{48}{1000}$ is greater than it, so that by annexing two Ternaries of Cyphers, to wit, 6 Cyphers to the Number propounded, you will not miss $\frac{1}{1000}$ Part of an Unit of the true Root, also by annexing three Ternaries of Cyphers, to wit 9 Cyphers, you will not miss $\frac{1}{1000000}$ Part of an Unit of the true Root.

Resolvend.

Divisor.

Resolvend.

Divisor.

Subtrahend.

Resolvend.

Divisor.

Subtrahend.

Resolvend.

Divisor.

Subtrahend.

To

To extract the Cube-root of a Fraction.

The Cube-root of a Fraction is thus found, viz. extract the Cube-root of the Numerator, which Root will be as a new Numerator; also the Cube-root of the Denominator, shall be as a new Denominator; so the Cube-root of $\frac{4}{27}$ is $\frac{2}{3}$; for the Cube-root of 8 is 2 for a new Numerator, also the Cube-root of 27 is 3 for a new Denominator: But here Note diligently, That the Fraction whose Cube-root is required, must be brought into its least Terms, before any Extraction can be made, so in this Fraction $\frac{1}{3}\frac{4}{4}$ being reduced to its lowest Terms is $\frac{2}{27}$, the Cube-root of this may be extracted, for the Cube-root of 8 is 2, also the Cube-root of 27 is 3 so that the Cube-root of $\frac{2}{27}$ equal, is found to be $\frac{2}{3}$.

I might here proceed to shew the Extraction of other Roots, as the *Biquadrate*, *Quadrato-Cube*, *Cubo-Cube*, and the like, of other Operations in Fractions, &c. but by Reason their Operation is exceeding tedious, difficult, and cannot be naturally understood, without the Knowledge of that most excellent, but mysterious Art called *Algebra*, which hath been most excellently, plainly, and learnedly set forth, by the most ingenious, learned, and able Mathematician of this Age, Mr *John Kersey*, my most honoured and worthy Master, to whom I owe all that I know in Numbers.

The Proof of the Extraction of the Cube-root.

The Extraction of the Cube-root is thus proved, by multiplying the Root cubically; so in the first Example 74 being multiplied by 74, the Square of it is 5476, which being again multiplied by 74, produceth the Cube-root 405224, which is equal to the given

given Number, therefore I conclude the Operation to be right.

But when after the Extraction is finished, there happeneth to be a Remainder, such Remainder must be added according as you work in the Proof of Division; and if the Sum maketh the given Number, the Work is rightly performed.

Now followeth the Use of the *Square* and *Cube-Roots*, in solving some Questions *Arithmetical* and *Geometrical*.



The Use of the Square and Cube Roots.

Proposition I.

To find a mean Proportional between two given Numbers.

Multiply the given Numbers, the one by the other, and extract the Square-root of the Product, so shall that Square-root be the mean Proportional sought.

E X A M P L E.

Let the given Numbers be 16 and 64, according to your Rule multiply 16 by 64, and the Product is 1024, the Square-root of which is 32, so that 32 is the mean Proportional between 16 and 64.



Thus

Given Number; therefore I conclude the Operation

Thus;

But when the Operation is finished, there
happens to be a Remainder which
is added according as it is in the Foot of
Division; and if the Sum is not the given Number
the Work is rightly performed.

1024 (32 Square-Root.

62)124

124

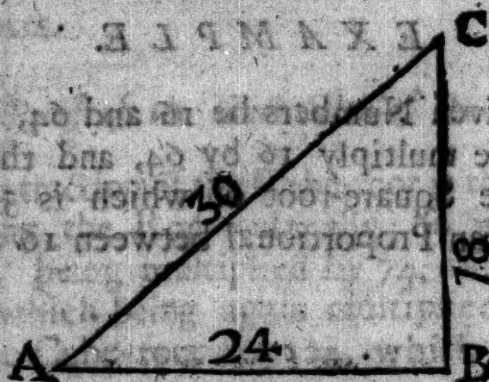
0

Proposition 2.

Having any two of the Sides of a right angled plain Triangle given, to find the third side.

As for EXAMPLE.

In the Triangle *A, B, C* the Base *A, B* is 24 and the Perpendicular *B, C* is 18, now I demand the length of the Hypothenuse?



To

Square and Cube Roots, 335

To Answer this Proposition, you must first Square the Base *A. B.* 24, which is 576, then Square the Perpendicular 18, which maketh 324; then add these two Sums together, and the Product is 900, and the Square-root of 900 is 30, which gives the Length of *A, C.*

This Proposition is of great Use in the Mensuration of Heights, Distances and other Mathematical Figures.

Proposition 3.

If the three Sides of a Piece of Land, that lies in the Form of a Triangle be 15 Perches, 14 Perches, and 13 Perches, what is the *Area* or Number of square Perches contained in that Triangle?

Answer, 84 Perches, or half an Acre and 4 Perches, which content is found out by this Rule,
viz.

From half the Sum of the three Sides of any plain Triangle, subtract each of the three Sides severally, and note the three Remainders; then multiply the said half Sum, and those three Remainders one into the other; that done, extract the Square-root of the last product. So shall such Square-root be the *Area*, or Content of the Triangle.

The Work.

21									
6									
126									
7									
882									
8									
7056									

The 3 Sides of the Triangle are

The Sum of the 3 Sides

The half of that Sum

Perches

15
14
13

} add

42 *Perches*

21

The

The three Remainders found out by subtracting
each Side from the half Sum

The Product arising from the continual mul-
tiplication of the four last Numbers

The Square-root of 7056 is the Content required,
to wit 84.

7056 (84 Perches; or $\frac{1}{4}$ an Acre and 4 Perches.

$$\begin{array}{r} 64 \\ 164 \overline{) 656} \\ \underline{656} \end{array}$$

Proposition 4.

Another EXAMPLE.

The three Sides of a Triangle

$$\begin{array}{r} 120.5 \\ 112.6 \\ \underline{90.3} \end{array}$$

The Sum of the three Sides

$$\underline{323.4}$$

The half of that Sum

$$161.7$$

The three Remainders found out
by subtracting each Side from
the half Sum.

$$\begin{array}{r} 41.2 \\ 49.1 \\ \underline{71.4} \end{array}$$

The Product arising from the continual Multipli-
cation of the four last Numbers, are

$$23355380 \quad 1096$$

The

Square and Cube Roots. 337

The Square-root of that Product is 4832.7+

Wherefore the Content of a plain Triangle, whose 3 Sides are as afore-recited 4832.7+ Perches, the Fractions of a Perch being neglected.

The Operation of the said last Sum; for the Benefit of the Learner I here have worked it.

161 . 7
41 . 2
49 . 1
71 . 4

Multiplied continually thus,

161 . 7
41 . 2

3234
1617
6468

6662.04
49.1

666204
5995836
2664816

327106.164
71.4

1308424656
327106164
2289743148

23355380.1096

The Square-Root

Z

The

The Square Root of that Product.

23355380.1096(4832.74 +

16

735

704

3153

2889

26480

19324

715610

676529

3908196

3866176

42020

Wherefore I conclude, that the Content of a plain Triangle, whose three Sides are 120.5 Perches, 112.6 Perches, and 90.3 Perches are 4832.74 + Perches, which being reduced, gives 30 Acres and 32 Perches, the Fraction of a Perch being neglected.

Proposition 1.

Of Solid Measure.

If the Side of a Cube be 12 Inches, how many cubical Inches are contained in that Cube?

Answer 1728.

RULE.

Square and Cube Roots: 339

R U L E.

Multiply the Length by the Breadth, and that Product by the Depth; as in this Example,

$$\begin{array}{r}
 12 \\
 12 \\
 \hline
 144 \text{ Square Inches.} \\
 12 \\
 \hline
 1728 \text{ Cubical Inches.}
 \end{array}$$

In like Manner, if the Side of a Cube of Stone be 2.53 Feet, the solid Content of that Cube will be 16.194277 Feet.

Thus,

$$\begin{array}{r}
 2.53 \\
 2.53 \\
 \hline
 759 \\
 1265 \\
 506 \\
 \hline
 6.4009 \\
 2.53 \\
 \hline
 192027 \\
 320045 \\
 128018 \\
 \hline
 16.194277 \text{ Feet.}
 \end{array}$$

Solid in Geometry, is the third Species of Magnitude, having three Dimensions, Length, Breadth, and Thickness.

plain
ches,
ches,
ches,

many

28.
L E.

Proposition 2:

How many solid Feet are contained in that Piece of Timber whose Length is 17 Feet $\frac{1}{2}$, 23 Inches Broad, and in Depth 2 Feet 7 Inches?

Feet

In Decimals by the Table.

$$\begin{array}{rcl}
 17 \cdot \frac{1}{2} \text{ Length} & = & 17 \cdot 5 \\
 0 \cdot 23 \text{ Inches Breadth} & = & 1 \cdot 9166 \\
 2 \cdot 7 \text{ Inches Depth} & = & 2 \cdot 5833
 \end{array}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{equal}$$

Multiply continually.

$$\begin{array}{r}
 17 \cdot 5 \\
 \times 1 \cdot 9166 \\
 \hline
 95830 \\
 134162 \\
 19166 \\
 \hline
 33 \cdot 54050 \\
 \times 2 \cdot 5833 \\
 \hline
 10062150 \\
 10062150 \\
 26832400 \\
 16770250 \\
 6708100 \\
 \hline
 86 \cdot 646173650
 \end{array}$$

Feet Inches Parts

Answer, 86 · 7 : 9 +

Proposition

Square and Cube Roots.

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Proposition 3.

There is a Stone come from *Purbeck*, that is 5 Feet 9 Inches Long, 3 Feet 11 Inches broad, and 2 Feet 8 Inches deep; I would know how many solid Feet are contained in this Stone?

By Decimals.

By Vulgar Arithmetick.

Inches	F.	I.	F.	I.	F.	I.
9 = .75	5	.9	3	.11	2	.8
11 = .9166	12		12		12	
8 = .6666						

Thus,

3.9166

5.75

1958330

2741662

1958330

22.5207950

. 2.666

1351247700

1351247700

1351247700

450415900

60.0404394700

69

47

483

276

3243

32

6486

9729

103776

12 Feet Inch Pts.

144)103776)720(60.00 $\frac{2}{3}$ 8

1008 72

Feet Inches

Answer, 60 . 00 . +

297

00

288

96

Z. 3

Pro-

Proposition 4.

A Vault dug 9 Feet deep, 4 Feet 6 Inches long, and three Feet 9 Inches broad, how many solid Yards?

45

9

40.5

3.75

2025

2835

1215

151.875 Feet.

Yards Feet Inches.

27) 151.875 (5.621

Answer 5 . 16 . 10 +

135

168

162

67

54

35

27

8

Proposition

Square and Cube Root.

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Proposition 5.

How many Yards of digging will there be in a Cellar that is 25 Feet 4 Inches long, 15 Feet 8 Inches broad, and 7 Feet and an half deep?

Decimally.

25.33 Length,
15.66 Breadth,
7.5 Depth.

25.33
15.66
15198
15198
12665
2533

Yds Feet
27)2975(110 : 5
27

27
27
05

396.6678

7.5
19833390
27766746
2975.00850

Proposition 6.

If the Breadth of a square Piece of Timber, having equal square Bases be 1.55 Foot, how far ought one to Measure along the Length of that Piece of Timber to make a Foot solid.

Answer, 416 Parts of a Foot, or 5 Inches very near.

Which Decimal is thus found, viz. multiply 1.55 by 1.55, the Product is 2.4025, then dividing 1 (to wit, 1 solid Foot by the Base 2.4025, the Quotient will be .416+ or 5 Inches ; fere.

Z 4

Thus,

Thus,

$$2.4025)1.000000(.416 = 5 \text{ Inches by Decimal Tables.}$$

39000

24025

149750

144150

5600

Proposition 7.

If a strait squared Piece of Timber be terminated by unequal Bases, whereof one contains 1.92 superficial Feet, the other .85 Feet, and the Length of that Piece of Timber be 17.4 Feet, what is the solid Content, or how many cubical Feet are contained in that Piece of Timber?

This Question is out of Mr Oughtred's Rules, Problem 21. Chap. 19. of his *Clavis Mathematica*.

The RULE.

Multiply the greater Base by the less, and extract the Square-root of that Product. Then multiply the Sum of the two Bases, and that Square will be $\frac{1}{3}$ Part of the Length of the Solid propounded, so shall the last Product be the solid Content required.

The

Square and Cube Roots. 345

The Operation.

The greater Base 1 . 92
 The lesser Base 0 . 85
 The Product of the Multiplication of } 1 . 6320
 those two Bases
 The Square-root of that Product 1 . 2774
 The Sum of that Square-root and the } 4 . 0474
 two Bases
 $\frac{1}{3}$ of the Length is 5 . 8
 The Product of the Multiplication of } 23 . 474 +
 the two last Numbers is the Solid
 Content required, viz.

Square-root

Length

1.2774	3)174(5.8; $\frac{1}{3}$ of the Length.
1.92	added 15
0.85	24
4.0474 the Sum	24
	0
1.92	4.0474 the Sum.
.85	5.8
960	323792
1536	202370
1.6320 Product	23.47492

The solid Content for Answer.

Proposition

Proposition 8.

To measure a Pyramid.

A Pyramid is a solid Figure, whose Base is a Polygon, and whose Sides are plain Triangles, their several Tops meeting together in one Point at the Top.

Now if the superficial Content of the Base of a Pyramid be 5.756 Feet, and the Height thereof 14.25 (which said Height is the Length of the Perpendicular Line, that falleth from the Top of the Pyramid to the Base) what is the solid Content of that Pyramid?

R U L E.

The Area of the Base of the Pyramid be multiplied by $\frac{1}{3}$ of the Height thereof, the Product shall be the solid Content of the Pyramid, Therefore $\frac{1}{3}$ of 14.25 is equal to 4.75, and 5.756 the Base be multiplied by 4.75 = 27.341 Feet, the Solidity of the Pyramid required.

$$\begin{array}{r} 5.756 \\ \times 4.75 \\ \hline \end{array}$$

$$\begin{array}{r} 4.75 \\ \times 5.756 \\ \hline \end{array}$$

$$\begin{array}{r} 28780 \\ \times 40292 \\ \hline \end{array}$$

$$\begin{array}{r} 23024 \\ \times 2734100 \\ \hline \end{array}$$

27.34100 Solid Feet.

22

21

20

19

18

17

16

15

14

13

12

11

10

9

8

7

6

5

4

3

2

1

0

Pro-

Square and Cube Roots. 347

Proposition 9.

To measure a Cylinder.

A Cylinder is a Solid, which may be well represented by a Stone-Roll; now if the Circumference of a Cylinder be 4.57 Feet, and the Length 3.25 Feet, what is the Solid Content of that Cylinder?

R U L E.

First by the Help of the given Circumference 4.57, find out the superficial Content of that Circle,

As 1 is to .079578 20.8849

20.8849

716202

318312

636604

636604

1591560

1.6619+

For 4.57 } multiplied
4.57

3199

2285

1828

20.8849

To find out the superficial Content of a Circumference, the Proportion is as

1 is to .079578:

Proposition 10.

To measure a Globe.

A Globe is a perfect round Body contained under one Plain; in the middle of the Globe, there is a Point called the Center, from whence all strait Lines drawn to the Out-side, are of equal length and called Semidiameters, the Double of any one of which is equal to the Diameter of the Globe.

Now if the Diameter of a Globe of Stone be 1.75 Feet, how many Feet solid are contained in that Globe?

Answer, 2.807 Feet, for as 21 is in Proportion to 11, or as 1 is to .5238, so is the Cube of the Diameter, to the solid Content of the Globe.

Therefore multiplying always the Cube of the Diameter by the Decimal .5238, the Product shall be the solid required.

So the Diameter 1.75 being first multiplied by itself, the Product will be 3.0625, which multiplied again by the said 1.75, gives for the Product 5.359375, to wit the Cube of the Diameter; which being multiplied by .5238, the Product thence arising will be 2.807 $\frac{1}{2}$, which is the Solidity of the Globe propounded.

Square and Cube Roots. 349

The Operation.

1.75
1.75

875
1225
175

3.0625
1.75

153125
214375
30625

5.359375
.5238

42875000
16078125
10718750
26796875

2.8072406250

Cube.

the Solidity of the
Globe.



C H A P.

CHAP. XXVI.

Simple-Interest.

- i.  Shall now proceed to *Interest of Money*, wherein the greatest and most useful Operations, are done by *Decimal Arithmetick*.

2. *Interest is either Simple or Compound.*

3. *Simple-Interest* is, when a Sum of Money is lent, and the Interest thereof, when due, is not paid, but kept in the Borrowers Hands, and yet becomes not a Part of the Principal, then it is called *Simple-Interest*. So if 100 *l.* be lent for two Years, the Simple-Interest thereof after the Rate of five Pounds for one Year, will be ten Pounds, viz. five Pounds due at the first Year's End, and five due at the second Year's End.

4. *Compound-Interest* is that, when a Sum of Money is lent, and the Interest when due is not paid, but kept in the Borrower's Hands, and by that Means becomes a Part of the Principal, then it is called *Compound-Interest*.

As for Instance, If *A.* lend to *B.* an 100 *l.* at the Rate of 5 *l.* per Cent. per Annum for three Years, and Compound Interest thereof is to be computed after the

Simple-Interest.

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the Rate of five Pounds for 100 *l.* there will arise besides the Simple-Interest of the Principal for three Years, the Interest of five Pounds, (due at the first Year's End) for two Years, and the Interest of 5 *l.* (due at the second Year's End) for one Year following.

This Analogy being agreed upon, the Manner of computing Simple-Interest for any Principal Money lent, or forborn any Time of Years propounded, will be the Work of the next following Pages.

What is the Interest of 175 *l.* 18 *s.* 11 *d.* for one Year, at the Rate of 5 *l.* for 100 *l.*?

$$\begin{array}{r}
 \text{175} \cdot \text{18} \cdot \text{11 at 5} \cdot \text{l. per Cent.} \\
 \hline
 \text{5} \\
 \hline
 \text{8} \overline{) 79 \cdot 14 \cdot 7} \\
 \underline{\text{20}} \\
 \text{15} \overline{) 94} \\
 \underline{\text{12}} \\
 \text{1} \overline{) 15}
 \end{array}$$

l. s. d.
Answer, 8 15 1

This Question is wrought as you have learned before.

If the Interest of 100 *l.* Principal for one whole Year be known, the Simple-Interest of any other Principal, for any Number of Days more or less than 365, may be found out by the following Rule,

Multiply

Multiply those three Numbers according to the Rule of continual Multiplication, to wit, the given Interest of 100 *l.* for a Year, the Principal whose Interest is required, and the Number of Days prescribed, reserving this last Product for a Dividend. Then multiply 365 by 100, and let that Product be your Divisor, so shall the Quotient be the Interest or Gain sought.

Note, here, that the two Principals, viz. 100 *l.* and the other proponded must be of one Denomination. Also the Interest required, must be of the same Denomination with the given Interest of 100 *l.*

For an Example of this Rule, Let it be required to find out the Interest of 400 *l.* for 7 Days, at the Rate of 6 *l.* per 100 *l.*

The Operation.

400. Principal.

6. Interest.

2400

7 Days.

16800 Dividend.

365 by 100

100

36500 Divisor.

36500)

Simple-Interest.

353

$$36500)168000000(.4602=9.2.4$$

$$146000 \dots$$

$$220000$$

$$229000$$

$$100002$$

$$73000$$

$$27000$$

As will appear by the brief Way of valuing a Decimal Fraction.

The Reason of the abovementioned Rule, will be manifest, by solving the same Question by two single Rules of Three, See Page 351.

A a

A

(500)

A TABLE for the ready finding the Decimal Parts of a Year, equal to any Number of Days.

Days-Decimal Parts.	Days-Decimal Parts.	Days-Decimal Parts.
1=0.002740	10=0.027397	100=0.273973
2=0.005479	20=0.054794	200=0.547945
3=0.008219	30=0.082192	300=0.821918
4=0.010959	40=0.109589	365=1.000000
5=0.013699	50=0.136986	
6=0.016438	60=0.164383	$\frac{1}{4}$ of a year=0.25
7=0.019178	70=0.191781	$\frac{1}{2}$ a year =0.5
8=0.021918	80=0.219178	$\frac{3}{4}$ of a year=0.75
9=0.024657	90=0.246575	

The Use of this Table.

Suppose it were required to find the Decimal Parts of a Year equal unto 135 Days.

Thus,

$$\begin{array}{rcl} 100 \text{ Days} & = & 0.273973 \\ 30 \text{ Days} & = & 0.082192 \\ 5 \text{ Days} & = & 0.013699 \end{array} \left. \vphantom{\begin{array}{r} 100 \\ 30 \\ 5 \end{array}} \right\} \text{add}$$

Hence 135 Days = 0.369864 Decimal.

Simple-Interest.

355

If 100 Gain 6 what will 400

6

2400

cd. X s. d.

100)2400(24 : 0 : 0

Than if 365 Days l. 24 Days what 7

20

480

12

5760

4

23040

7

1528

12 s. d.

365)161280(441(110(9 : 2 1/2

1460 : : 108

1

1528

2

1460

680

365

315

A a 1

What

What is the Interest of 1000 l. for 131 Days at the Rate of 6 l. per Cent. per Annum?

$$\begin{array}{r}
 1000 \\
 \times 6 \\
 \hline
 6000 \\
 131 \\
 \hline
 36500 \\
 6000 \\
 18000 \\
 6000 \\
 \hline
 36500)786000.000(21.534 \\
 9000.
 \end{array}$$

21.534 + is 21 l. 10 s. 8 d. $\frac{1}{4}$ for Answer.

Suppose it is required to find what Sum 780 l. 15 s. will amount to in 3 Years and 179 Days, at 5 l. 10 s. per Cent.

By the Table thus,

$$\begin{array}{rcl}
 3 \text{ Years} & = & 3.000000 \\
 100 \text{ Days} & = & 0.273973 \\
 70 & = & 0.191781 \\
 9 & = & 0.024657
 \end{array}
 \left. \vphantom{\begin{array}{rcl} 3 \text{ Years} \\ 100 \text{ Days} \\ 70 \\ 9 \end{array}} \right\} \text{add}$$

Hence 3 Years and 179 Days is = 3.490411 Time.

Simple-Interest.

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Principal is 780.75 } multiply
Time 3.4904 }

312300
7026750
312300
234225

2725.129800 } multiply by the Inter
0.0555 } or Rate.

13625649000
13625649000

149.8821 +

l. s. d.

That is 149 : 17 : 7 the Interest.
To which add 780 : 15 : 0 the Principal.

930 : 12 : 7 the Amount re-
quired.

*The Way of summing up Annuities in Arrear, with Al-
lowances of Simple-Interest.*

If an Annuity or yearly Rent of 134 l. 10 s. 6 d.
be all forborn till the End of four Years, what will it
then amount unto at the Rate of 6 l. per Cent. per Ann.
for each Year's Rent, from the Time on which
it was due, until the End of the said Term of four
Years?

l. s. d.

Answer, 586 : 10 : 6 + $\frac{26}{100}$.

A 3

To

Simple-Interest.

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T A B L E the Second.		
Which sheweth in Pounds and Decimal Parts of a Pound, the Amount of one Pound Annuity, being forborn to the End of any Number of Years under 31 Simple Interest, being computed after the Rate of 6 per Cent. per Annum.		
Years.		
1	1.00	11 14.30
2	2.06	12 15.96
3	3.18	13 17.68
4	4.36	14 19.46
5	5.60	15 21.30
6	6.90	16 23.20
7	8.26	17 25.16
8	9.68	18 27.18
9	11.16	19 29.26
10	12.70	20 31.40
		21 33.60
		22 35.86
		23 38.18
		24 40.56
		25 43.00
		26 45.50
		27 48.06
		28 50.68
		29 53.36
		30 56.10

What is the Amount of an Annuity of 250 l. 10 s. being forborn to the End of 12 Years, allowing Simple-Interest after the Rate of 6 l. per Cent. per Ann.

Answer, 399 l. 15 s. 11 d. $\frac{1}{2}$.

Thus,

The given Annuity 250.5
The Tabular Number for 15.96
12 Years.

15030

22545

12525

2505

l.

s.

d.

399.7980 = 399 15 11 $\frac{1}{2}$.

A a 4

Ex-

Examp. 3. What is the Amount of an Annuity of 80 l. a Year being forborn 7 Years at the Rate of 6 l. per Cent. per Annum. Answer, 660 l. 16s.

The given Annuity 80 l.

Number of 7 Years 8.26

480

160

640

660/80

Answer, 660 l. 16 s. by the valuing of the Decimals.

TABLE the Third.		
Which sheweth the worth of a Pound Annuity to continue any Number of Years under 31 Years Simple-Interest, being computed at 6 per Cent. per Annum.		
Years.		
1	.943396	11 8.25133
2	1.836253	12 8.832729
3	2.683710	13 9.394526
4	3.490161	14 9.938004
5	4.259391	15 10.464319
6	4.994685	16 10.974523
7	5.698900	17 11.469572
8	6.374575	18 11.950341
9	7.023925	19 12.437630
10	7.648235	20 12.892175
		21 13.334652
		22 13.765686
		23 14.175524
		24 14.585360
		25 14.985360
		26 15.375985
		27 15.757664
		28 16.120798
		29 16.485761
		30 16.842904

The Use of this Table you will see by the ensuing Examples.

Ex.

Simple-Interest. 361

Example 1. How much present Money must be paid for an Annuity or Rent of 100 *l.* per Ann. to continue for five Years, Rebate being made at the Rate of 6 *l.* for 100 *l.* for one Year at Simple-Interest?

Look into Table the Third, and you will find in the Column against 5 Years 4.25939 + and then take the Rent or Annuity, which is here 100, and by multiplying them you will find the Answer to be 425 *l.* 18 *s.* 9 *d.* $\frac{1}{4}$ very near.

The given Sum	<i>l.</i> 100 : 00
Five Years Tabular Number	4.25939 +

4.25939	
100	
425.93900	= 425 : 18 : 9 $\frac{1}{4}$

Example 2. A Gentleman going to Travel, hath a Lease of 18 Years yet to come, of the yearly Value of 175 *l.* to be sold for ready Money, and the Purchaser is to be allowed Rebate after the Rebate of 6 *l.* per Cent. per Ann. Simple-Interest, I would know the present worth of this Lease?

18 Years Tabular Number	11.950341	} multiply
The given Sum 175	175	
59751705		
83652387		
11950341		
2091309675		

So

So that by this Work you find the Answer to be 1091 *l.* 6 *s.* 0 *d.* $\frac{1}{4}$ very near.

There might have been made Tables for other Rates of Interest, but *Simple-Interest* being seldom allowed in the purchasing or valuing Leases or Annuities, they being generally purchased at *Compound-Interest*; for at *Simple-Interest*, an Annuity will be over valued, so saith Sir *Jonas More*, Sir *Samuel Moreland*, and Mr. *Kersey* writeth, That all Computations of Annuities or Leases, ought to be laid aside as useles, and therefore I forbear, and proceed to *Compound-Interest*.



C H A P. XXVII.

Compound-Interest.



Compound-Interest or *Interest* upon *Interest*, is, when any Sum of Money is Lent, and the Interest when due, not paid, but kept in the Borrowers Hands, is by that Means become a Part of the Principal, then it is called *Interest* upon *Interest*.

As for Example. If *A.* lend to *B.* 100 *l.* at the Rate of 6 *l.* per Cent. for a Year, and he pays not his said Interest of 6 *l.* it is then very reasonable that *B.*'s Debt then must be increased to 106, and if this be continued in *B.*'s Hand, till the End of the second Year, there will then be due to *A.* the Increase of 106, (to wit) 112 *l.* 7 *s.* 2 *d.* $\frac{1}{4}$, which will become a new Stock for the third Year if not paid.

Whereby

Compound Interest. 363

Whereby it is plain, That if it be lawful to take Interest at all, it is lawful to take *Compound-Interest*.

An Illustration of an Example upon this Rule, (I will work both Vulgar and Decimal) by reason I would make all things as plain and easy as I can.

So if 300 *l.* be put out at 6 *l.* per Cent. per Annum Interest upon Interest for 4 Years, what will it then amount unto?

Operation by Vulgar Arithmetick.

300 at 6 per Cent.

Answer, as by the Operations

6
18|00

l. *s.* *d.*
378 : 14 : 9 $\frac{1}{4}$.

Increase the 2d Year.

318 : 0 : 0
6

l. *s.* *d.*
318 : 0 : 0
19 : 1 : 7

19|08 : 0 : 0
20

337 : 1 : 7 | Increase 2d Year.

The 3 Year

160
12

337 : 1 : 7
6

720
4

3022 : 9 : 6
20

080

449
12

l. *s.* *d.*

594
4

337 : 1 : 7
20 : 4 : 9 $\frac{1}{4}$

336

357 : 6 : 0 $\frac{1}{4}$
Increase 3d Year.

357

$$\begin{array}{r}
 357 : 6 : 0 \frac{1}{4} \\
 \hline
 21 : 43 : 16 : 4 \frac{1}{4} \\
 \hline
 20 \\
 \hline
 8 \text{ } 76 \\
 \hline
 12 \\
 \hline
 9 \text{ } 16 \\
 \hline
 4 \\
 \hline
 0 \text{ } 66
 \end{array}$$

This said last Question performed Decimally.

$$\begin{array}{r}
 100.106 :: \left\{ \begin{array}{l} 300 \\ 318 \\ 337.08 \\ 357.3048 \end{array} \right. \left\{ \begin{array}{l} 318 \\ 337.08 \\ 357.3048 \\ 378.743088 \end{array} \right.
 \end{array}$$

Which is $378 : 14 : 10 \frac{1}{4}$.

Whereby you see that 300 *l.* being put to Interest, after the Rate of 6 *l.* per Cent. will at the first Year's End be increased to 318, and being put out for the second, Year will be increased to 337.08; and again, this 337.08 being made a Principal, and being put out at the same Rate for the third Year will be augmented to 357.3048; and at the fourth Year's End it will amount unto 378.743088, which is the Number required by the Question.

From what has been said by Way of Explication, the following Table 1st, is deduced the Use, and Construction is afterwards declared.

Table

Compound-Interest.

365

Years.	Table the First. Shewing the Amount of one Pound for 31 Years at 5 and 6 per Cent. Compound-Interest.		Table the Second. Shewing the Rebate of one Pound for 31 Years at 5 and 6 per Cent. Compound-Interest.	
	5	6	5	6
1	1.050000	1.060000	.925381	.943396
2	1.102500	1.123600	.907030	.889996
3	1.157625	1.191016	.863838	.839619
4	1.215506	1.262477	.822703	.792093
5	1.276281	1.338225	.783526	.747258
6	1.340096	1.418519	.746215	.704960
7	1.407100	1.503630	.710683	.665057
8	1.477455	1.593848	.676839	.627412
9	1.551328	1.689479	.644609	.591898
10	1.628895	1.790848	.613913	.558394
11	1.710339	1.898298	.584679	.528787
12	1.795856	2.012196	.556837	.496969
13	1.885649	2.132928	.530321	.468839
14	1.979932	2.260904	.505068	.442301
15	2.078928	2.396558	.481017	.417265
16	2.182874	2.540352	.458111	.393647
17	2.292018	2.692773	.436296	.371364
18	2.406619	2.854339	.415520	.350343
19	2.526950	3.025599	.395734	.330513
20	2.653298	3.207135	.376889	.311804
21	2.785962	3.399564	.358942	.294155
22	2.925261	3.603537	.341849	.277505
23	3.071524	3.819750	.325571	.261797
24	3.225102	4.048935	.310067	.246978
25	3.386355	4.291871	.295302	.232998
26	3.555673	4.549383	.281246	.219810
27	3.733456	4.822346	.267848	.207368
28	3.920125	5.111687	.255093	.195630
29	4.116135	5.418388	.242946	.184556
30	4.321942	5.743491	.231377	.174110
31	4.538039	6.088101	.220359	.164254

Quest. 1.

Quest. 1. What will 250 *l.* amount unto being forborn seven Years, Interest upon Interest, being computed at the Rate of 5 *l.* per Cent. per Ann. which is thus found out ?

First, looking into the first Column of the first Table, which hath the Figure 5 placed at the Head of it, I find right against 7 Years the Number 1.407100, which shews that 1 *l.* being continued 7 Years at 5 *l.* per Cent. per Ann. *Compound-Interest*, and all forborn until the End of 7 Years, will be augmented unto 351.775000; that is 351 *l.* 15 *s.* 8 *d.* $\frac{1}{4}$; (which is to be found out by multiplying the tabular Number 1.407100 by the Number of Money forborn which in this Question is 250 *l.* See the Work.

$$\begin{array}{r}
 1.407100 \\
 250 \\
 \hline
 70355000 \\
 2814200 \\
 \hline
 351.775000 \text{ that is } 351 : 15 : 8 \frac{1}{4}
 \end{array}$$

Quest. 2. If 4325 *l.* 15 *s.* 6 *d.* be put out at *Compound-Interest* for 12 Years, at 6 *l.* per Cent. per Annum, what is the full Sum I must then receive (that is) both Principal and Interest at the End of the said 12 Years ?

Answer, 8704 *l.* 6 *s.* 0 *d.* $\frac{1}{4}$.

The

Compound-Interest. 367

The Work.

4325.775 the Money put out at 6 l.
2.012196 Table Number.

35954650
38931975
4325775
8651550
4325775
86515500

8704307151900 that is 8704:6:0 $\frac{1}{4}$.

Quest. 3. What will 200 l. amount unto forborn
5 Years, at the Rate of 6 l. per Cent. Compound-
Interest.

Answer 267 l. 12 s. 3 d. +

1.338225 Tabular Number.
200 Money.

2671645000 Answer, 267 l. 12 s. 3 d.

Table 2d. Of Rebate at Compound-Interest.

There is a Debt of 958 l. 15 s. 7, which is not
due until 9 Years hence; but 'tis agreed to be paid
in present Money, what Sum must the Creditor re-
ceive, allowing the Rebate or Discompt of 6 l. per
Cent. per Ann.

Look into Table the 2, and against 9 Years at 6 l.
per Cent. you will find this Tabular Number .591898,
which being multiplied by 958.78, the Product will
be 567.49926444 = 567 l. 10 s.

The

The Work .591898
958.78

4735184

4143286

4735184

2959490

5327082

567|49996444 = 567 : 10

Let it be required to find how much ready Money will discharge a Debt of 378 Pounds, payable at the End of 4 Years at the Rate of 5 *l.* per Cent. Compound-Interest?

Look into Table the Second against 4 Years, at the Rate of 5 *l.* per Cent. per Annum, you will find this Tabular Number .822703. which being multiplied by 378 is 310.9817.

.822703

378

6581624

5758921

2468109

310|981734 or 310 : 19 : 3 fere.

Take another Example for the Use of the Second Table.

What ready-Money will pay a Debt of 36 *l.* 10 *s.* due 21 Years hence at 5 *l.* per Cent.

Tabular Number .358942

36.5

1794710

2153652

1076826

Answer, 13 *l.* 2 *s.* 4

13|1013830 = 13 : 2

Table

Compound-Interest.

369

Table the Third.
Shewing the present Worth
of 1 l. Annuity to continue
for 31 Years at 5 and 6
p. Cent. Comp. Interest.

Years.	5	6
1	0.952381	0.943396
2	1.859410	1.833392
3	2.723248	2.673012
4	3.545950	3.465105
5	4.329477	4.212363
6	5.075692	4.917324
7	5.786373	5.582381
8	6.463212	6.209792
9	7.107821	6.801691
10	7.721734	7.360086
11	8.306414	7.886873
12	8.863251	8.383843
13	9.393572	8.852682
14	9.898646	9.294983
15	10.379658	9.712248
16	10.837769	10.105894
17	11.274065	10.477258
18	11.689586	10.827602
19	12.085320	11.158115
20	12.462209	11.469920
21	12.821152	11.764075
22	13.163002	12.041580
23	13.488573	12.303377
24	13.798641	12.550356
25	14.093944	12.783354
26	14.375184	13.003164
27	14.643033	13.210531
28	14.898127	13.406162
29	15.141073	13.500719
30	15.372450	13.764829
31	15.592810	13.929984

Table the Fourth.
Shewing what Annuity
to continue for 31 Years
1 l. will purchase at 5
& 6 p. Cent. Comp. Int.

5	6
1.050000	1.060000
.537805	.543637
.367208	.374110
.282012	.288591
.230952	.237396
.197017	.203363
.172820	.179135
.154722	.161036
.140690	.147022
.129505	.135868
.120389	.126793
.112825	.119272
.106456	.1102960
.101023	.107585
.096342	.102963
.092270	.098932
.088699	.095445
.085546	.092356
.082745	.089621
.080242	.087184
.077996	.085004
.075970	.083045
.074137	.081278
.072741	.079679
.070952	.078227
.069564	.076904
.068292	.075697
.067122	.074592
.066045	.073579
.065055	.072649
.064132	.071792

B b

There

There is no Difference betwixt the Use of these Tables, and those going before, as will be seen in the Manner of the working of these Tables.

As for *EXAMPLE.*

An Annuity of 80 *l.* per Ann. clear from all Taxes and Incumbrances whatsoever to be sold for 12 Years, what ready Money is it worth, to be purchased at 5 *l.* per Cent. Compound-Interest?

Table the 3d. Tabular Number over-against 5 *l.* per Cent. and over against 12 Years is 8863251, then multiply by 80, the given Annuity.

$$\begin{array}{r}
 8863251 \\
 \times 80 \\
 \hline
 709060080
 \end{array}$$

So the Answer is 709 *l.* 0 *s.* 4 *d.*

A Gentleman sells an Estate of 100 *l.* a Year clear, to be paid yearly for 21 Years at the Rate of 6 *l.* per Cent. Compound-Interest, what ready Money must he receive?

Table 3. Tabular Number answering to 2 Years

$$\begin{array}{r}
 1176185 \\
 \times 21 \\
 \hline
 1176185
 \end{array}$$

Answer, 1176 *l.* 8 *s.* 7 *d.*

TABLE

Compound-Interest

371

T A B L E the Fifth:

A Table shewing the Amount of one Pound Annuitie
for 30 Years, or under forborn, at 5, 6, 7 or 8 Tears
Compound-Interest.

	4	6	7	8
1	1.00000	1.00000	1.00000	1.00000
2	2.05000	2.06000	2.07000	2.09000
3	3.15250	3.18360	3.21490	3.24640
4	4.31012	4.37461	4.43994	4.50611
5	5.52563	5.63709	5.75073	5.86660
6	6.80191	6.97531	7.15329	7.33592
7	8.14200	8.38383	8.65402	8.92280
8	9.64910	9.89746	10.25980	10.63662
9	11.02656	11.49131	11.97798	12.48755
10	12.57789	13.18079	13.81644	14.48656
11	14.20678	14.97164	15.78359	16.64548
12	15.91712	16.86994	17.88845	18.97712
13	17.71298	18.88213	20.14064	21.49529
14	19.59863	21.01506	22.55048	24.21492
15	21.57856	23.27596	25.12902	27.15211
16	23.65749	25.67252	27.88805	30.32428
17	25.84036	28.21287	30.84021	33.75022
18	28.13238	30.90565	33.99903	37.45024
19	30.53900	33.75999	37.37896	41.44626
20	33.06595	36.78559	40.99549	45.76196
21	35.71925	39.99272	44.86517	50.42292
22	38.50521	43.39228	49.00573	55.45675
23	41.43047	46.99582	53.43614	60.89329
24	44.50199	50.81557	58.17667	66.76475
25	47.72709	54.86451	63.24903	73.10593
26	51.11345	59.15638	68.67646	79.95441
27	54.66912	63.70576	74.48382	87.35076
28	58.40258	68.52810	80.69709	95.33882
29	62.32271	73.63979	87.34652	103.96593
30	66.43884	79.05818	94.46078	113.28321

The Use of this said Table the Fifth will be made manifest, and easily comprehended by the Manner of solving these Questions following.

Quest. 1. If an Annuity of 30 *l.* payable by yearly Payments for 16 Years, be all forborn or unpaid, until the End of the said Term, what will it then amount unto upon a Computation of Interest upon Interest, at the Rate of 6 *l.* per Cent. per Ann.

Answer, 770 *l.* 3 *s.* 2 *d.* + as by the following Operation is evident.

Tabular Number 25.67252

The Money given 30

770 | 17560

770 *l.* 3 *s.* 2 *d.* +

Quest. 2. What will an Annuity of 120 *l.* per Ann. amount to, forborn 7 Years at 7 *l.* per Cent. Compound Interest?

8.65402

120

17308040

865402

103848240

Answer, 1038 *l.* 9 *s.* 2 *d.*

Quest. 3. An annual Rent of 365 *l.* paid yearly, and discontinued to be paid for 12 Years, is to be paid; what will it then amount unto at the End of the said Term. at the Rate of 5 *l.* per Cent. Compound-Interest?

Tabular

Tabular Number 15.91712

365

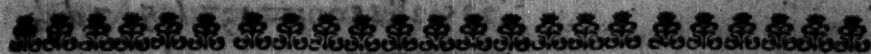
7958560

9550272

4775136

580974880

Answer 5809 l. 15 s. +



Questions to exercise the Rules, and Tables foregoing.

Quest. 1. **H**OW many Years Purchase will an Annuity (issuing out of an Estate) for 21 Years, to begin presently, be worth, if it were to be sold for ready Money, at the Rate of 6 l. per Cent. accounting Interest upon Interest. Thus,

Seek in the Column of Table the Third for 21 Years, and you will find against 21 Years this Number 11.764075, which shews you, that the said Annuity is worth 11 Years $\frac{1}{4}$ Purchase, if at 8 l. per Cent. then 19 Years Purchase.

Quest. 2. A Landlord lets a Lease of a House and Land in the Country for 21 Years, and it is agreed to take 100 l. for that Lease, and a yearly Payment of 30 l. what Fine or present Money must the Tenant give, to bring down the Rent to 10 l. per Ann. agreed on both Sides to accompt at 6 l. per Cent. Interest upon Interest.

B b 3

Direction.

Compound-Interest,

Direction: 1 2 3 4 5 6 7 8 9 10 11 12

Subtract 10 from 30, there will remain 20 *l.* then seek in the Column of Table the Third, and against 21 Years, you will find 11.764075, which being multiplied by 20, the Product gives the Landlord the present worth.

Answer, 235 *l.* 5 *s.* 7 *d.* $\frac{1}{2}$.

Thus found 11.764075

$$235 | 281500 = 235 \text{ l. } 5 \text{ s. } 7 \text{ d. } \frac{1}{2}$$

Quest. 3. A Gentleman hath a Mind to dispose of the Rent of a House of 25 *l.* a Year for 8 Years, at 6 *l.* per Cent. Compound Interest, payable by yearly Payments, what is it worth in ready Money by Table the Third?

Table the Third against 8 Years	6.209792
	25
	31048960
	12419584
Answer, 155 <i>l.</i> 4 <i>s.</i> 10 <i>d.</i>	155 244800

Quest. 4. A Landlord demands a Fine, or present Sum, for a Lease of 127 *l.* per Ann. to continue 7 Years, what is the Sum he must receive, agreeing at the Rate of 6 *l.* per Cent. Compound-Interest.

Tabular Number, the 3d is 5.58238

by 127

$$\begin{array}{r} 3907666 \\ \text{Answ. } 708 \text{ l. } 19 \text{ s. } 2 \text{ d. } \frac{1}{4} \end{array}$$

1116476

558238

$$708 | 96226 = 708 \text{ l. } 19 \text{ s. } 2 \text{ d. } \frac{1}{4}$$

Quest.

Compound-Interest.

375

Quest. 5. What Annuity, to begin presently and to continue 12 Years, 500 *l.* in present Money will purchase, Compound-Interest being computed at 5 *l.* per Cent. per Annum?

Tabular Number the 4th is .112825
Money 500

Answer, 56 *l.* 8 *s.* 10 *d.* 56|412500

For as the Value found is in Proportion to the supposed Annuity, so is the Sum of Money propounded to the Annuity required.

Quest. 6. It is required to find the present Worth of 10 *l.* for eleven Years, at 6 per Cent. Compound Interest?

By Table the 3d against 11 Years, Tabular Number is 7.88687
10

Answer, 78 *l.* 17 *s.* 10 78|86870

Quest. 7. A Gentleman has 9 Years to come in a Lease of 175 *l.* a Year, and he is desirous to enlarge his time eleven Years more (*viz.* to enjoy his Lease 20 Years yet to come,) I desire to know, what Sum of Money must he pay down for that Purchase, to be allowed at the Rate of 6 *l.* per Cent. Compound-Interest.

Direction.

In the first Place you must find what 175 *l.* per Ann. is to be let for 11 Years, which are to begin after 9 Years are expired, of that Lease at 6 *l.* per Cent. Compound-Interest, ready Money: Therefore 175 *l.* a Year for 11 Years is 1380 *l.* 4 *s.* 4

B b 4

Thus

Thus found by Table the Third.

Tabular Number 7.88687
Money 175

3943435

5520809

788687

1380|20225 = 1380 : 4 +

Thus you find, that 1380 Pounds 4 Shillings, the present worth, supposing the Rent were immediately entred upon : But because it is not so, therefore your next Work must be to find, what Principal or Sum of Money, being put out to Interest for nine Years Discount at 6 l. per Cent. Compound Interest.

Look into Table the Second, that sheweth the Rebate of Money, and against nine Years, and you find Tabular Number .591898

1380

47351840

1775694

591898

816|819240 = 816 : 16 +

Answer 816 l. 16 s. 4 d is the true present worth of that Lease in Reversion, as was required in yearly Rents.

Quest. 8. One would bestow 630 l. to purchase a present yearly Rent, or Annuity of 60 l. to be paid by yearly Payments, the Question is to know, how many Years, the said Annuity ought to be continued,

Compound-Interest.

377

tinued, Compound-Interest at 6 l. per Cent. per Ann.
being allowed on both Sides.

Answer, 17 Years and 23 Days, near.

Thus,

First divide 630 by 60, the Quotient will be 10.5.

$$60 \overline{) 630} (10.5$$

$$60 \cdot$$

$$30$$

Which shews, that 10 Years and a half purchase are given for the Annuity ; then searching for 10.5 in Table the Third in the Column of 6 l. p. Cent. I find it not exactly, but the nearest less than it is 10.47725 which standing right against 17 Years, and the next greater than 10.5. is 10.82760, which is placed against 18 Years ; from whence I infer, that the Annuity must continue 17 Years and more ; yet less than 18 Years. Now the proportional Parts of a Year to be added to 17 Years, may be found out near enough for Use : Thus by subtracting the said lesser Tabular Number 10.47725 from the greater 10.82760

$$10.82760$$

$$10.47725$$

$$\hline \text{Rest } .35035$$

Also subtracting 10.47725 from

10.50000 the Remainder gives

$$10.47725$$

$$\hline .2275 \text{ near } 23 \text{ Days.}$$

Answer, 17 Years 23 Days, near.

Quest. 9. There is a Lease of certain Lands worth 32 l. a Year more than the Rent paid to the Lord for it, of which Lease 7 Years are yet to come ; but the Lessee is desirous to take a Lease in Reversion for

for 21 Years, to begin when his old Lease is expired.

The Question is, what Sum of Money is to be paid for this Lease in Reversion, accounting Compound-Interest at 6 l. per Cent.

Answer, 250 l. 7 s. 2 d.

Thus found,

First, by Table the 3d, find out how much 32 l. yearly Rent for 21 Years is worth in ready Money, as if the 21 Years were to begin presently at 6 l. per Cent.

Tabular Number 11.764075

Money 32

23528150

35292215

376|450300 = 376 : 9

Then by Table the Second, find what 376.450300, due at the End of 7 Years to come, is worth in ready Money, so will it be 250 l. 7 s. 2 d.

Table the Second.

.665057

376.45

3325285

2660228

3990342

4655399

1995171

250|3607076 = 250 : 7 2

So that by taking this 250 l. 7 s. 2 d. which the Reversion is worth, after your 7 Years are expired ;
out

out of the 376 *l.* 9 *s.* which the whole 28 Years is worth; you rebate for your 7 Years in being 126 *l.* 1 *s.* 10 *d.* so that then there will remain the said 250 *l.* 7 *s.* 2 *d.* which is to be paid in ready Money to make up your Lease 21 Years.

Quest. 10. Suppose there was paid 3205 *l.* 5 *s.* for an Annuity, or a Lease of 250 *l.* a Year, to continue 21 Years, what Rate of Interest *per Cent.* is allowed to the Purchaser.

Answer 5 *l.*

Thus found,

Divide 3205.2500 by 250, and the Quotient is 12.8210.

$$\begin{array}{r} 250 \overline{) 3205.2500} (12.8210 \\ 250 \cdot \cdot \cdot \cdot \cdot \end{array}$$

705

500

2052

2000

525

500

250

250

00

Then looking for 12.8210 in Table the 3d, in a right Line passing from 21 Years, equi-distant to the head Line of the Table I find 12.821152, which stands in the Column of 5 *l.* *per Cent.* whence I conclude, That 5 *l.* *per Cent.* *per Ann.* is the Rate of Interest allowed to the Purchaser.

Quest. 11.

Quest. 11. A young Merchant, being beyond the Sea, at his Return of 26 Years, found that his Brother at his Decease had left him from the said Time of 26 Years an Estate of 30 Pounds a Year, which had been received annually by the Executor, to be laid out according to the Will, for the Advantage of his Brother.

Now the Question is to know, what was then due to the said Merchant at his Return from the Sea, Compound-Interest being computed at 6 *l.* per Cent. per Ann.

First, know what Principal will in one Year gain 30 Pounds.

$$\begin{array}{r}
 \text{If } 6 \text{ } l. \text{ Interest make } 100 \text{ ——— what will } 30 \\
 \quad \quad \quad 30 \\
 \quad \quad \quad \text{—— } l. \\
 \quad \quad \quad 6)3000(500 \quad \text{Answer, } 500
 \end{array}$$

Then by the Table the First, to know, what 26 Years will come to, I find the Tabular Number against 26 Years 4.54938. Then

$$\begin{array}{r}
 \text{If } 1 \text{ ——— } 4.54938 \text{ ——— what } 500 \\
 \quad \quad \quad 500 \\
 \text{—————} \quad \quad \quad l. \quad s. \quad d. \\
 2274 | 69000 \quad \text{Answer, } 2274 : 13 : 3
 \end{array}$$

From which if you subtract 500 *l.* the Principal, there will Remain 1774 *l.* 13 *s.* 3 *d.* due to the Merchant at his Return.

$$\begin{array}{r}
 \quad \quad \quad l. \quad s. \quad d. \\
 2274 : 13 : 3 \\
 500 : 00 : 0 \\
 \text{—————} \\
 1774 : 13 : 3
 \end{array}$$

Quest. 12.

Compound-Interest: 381

Quest. 12. Lastly, There is a Lease of certain Lands to be let for 14 Years for 250 *l.* Fine, and 44 *l.* yearly Rent. But the Tenant is desirous to pay less Rent, viz. 20 *l.* per Ann. and so to give a greater Fine; the Question is, what Fine ought to be paid in ready Money, to compute at 5 *l.* per Cent. per Annum Compound-Interest.

First find the Difference between the Rents, which will be 24 Pounds.

44

20

24 Diff.

Then by Table 3d, seek what Annuity or Rent of 24 *l.* per Ann. to continue 14 Years, is worth in ready Money at 5 *l.* per Cent. per Annum, so you will find

Tabular Number 9.898640

24 Years.

39594560

12797280

237561360 Answer, 237 *l.* 6 *s.* 4

Which said 237 *l.* 6 *s.* 4. being added to the Fine 250 *l.* gives 487 *l.* 6 *s.* to be paid down, to Answer the Question.

250 first Fine.

237 second Fine.

— *l.*

487:6

How

How to find out Tabular Numbers for Years exceeding 30.

IT oftentimes falls out, that the Number of Years proposed in a Question, may exceed the Number of Years limited in the foregoing Tables: In such Cases, that Defect may be supplied by the Method used in the Solution of the following Questions.

Quest. 1. Suppose 100 *l.* were put out to Interest, at 5 *l.* per Cent. Compound Interest for 40 Years, what will it then amount to?

This Question is thus to be answered, Take any two Numbers, which make up 40 in the first Table of this Book, and in the Column of 5 *l.* per Cent. which stands against those two Numbers, and multiply them together, and then multiply that Product by 100, the given Sum, and the last Product will be your Answer.

As suppose 30 and 10, or 26 and 14, or 29 and 11, but we will pitch upon 30 and 10, and the Tabular Number against 30 is 4.321942, and against 10 is 1.628895, which two Numbers being multiplied, produce $703|996484660 = 773 \text{ l. } 19 \text{ s. } 4 \text{ d. near.}$

By

By Table the First.

$$\begin{array}{r} 3555673 \\ 1979932 \end{array} \left. \begin{array}{l} \\ \end{array} \right\} \text{multiply}$$

7111346

10667019

32001057

32001057

24889711

32001057

3555673

7039990754236

100

$$703999075423600 = 703 : 19 : 4$$

Thus you see the Answer is the same.

Take another *Example*; Suppose 456*l.* to be payable at the End of 56 Years to come, what is it at present Worth, Rebate being allowed at 5*l.* per Cent. Compound-Interest?

This Question is to be answered in the same Manner, as those belonging to Table the Second.

The given Time being 56 Years, I pitch upon 30 and 26, and the Tabular Number against 30, is .231377, and that against 26 is 281246. which must be multiplied by one another.

Thus,

Compound-Interest.

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Thus,

$$\begin{array}{r}
 .231377 \\
 .281246 \\
 \hline
 1388262 \\
 925508 \\
 462754 \\
 231377 \\
 1851016 \\
 462754 \\
 \hline
 .065073855742 \\
 456 \\
 \hline
 390443134452 \\
 325360278710 \\
 260295422968 \\
 \hline
 291673588218352 \\
 \hline
 \hline
 \text{l. s. d.} \\
 \text{Answer, } 29 : 13 : 3
 \end{array}$$

There is a Debt of 258 l. 15 s. 7 d. which is not due until 48 Years hence, but they do agree to pay it in present Money, what Sum must be paid in ready Money, the Rebate or Discount, at 6 l. per Cent. per Annum?

The Number of Years being 48, I take 29. and 20 for the Numbers.

Cc

Look

386

Compound-Interest.

Look into Table the Second against 28 Years,
you shall find .195630, and against 20 Years
.311804.

.195630 } multiply
.311804 }

782520
15650400
195630
195630
586890

.609982165200
258.78

4879857321600
4269875156400
4879857321600
3049910826000
1219964330400

157.85118471045600

l. s.
Answer, 157 : 17-4 as by the Operation

Again,

Compound-Interest.

387

Again, if 540 l. be put forth at 5 l. per Cent. Compound Interest, and both Principal and Interest be forborn until the End of 45 Years, what will then be due?

The Number of Years being 45 I take 15 and 30, then looking into

Table the first against 30, is 4.321942
And against 15, is 2.078928

4.321942

2.078928

34575536

8643884

38897478

34575536

30253594

86438840

8985006238176 the Increase of 1 l. forborn
540 (45 Years)

359400249527040

44925031190880

4851903368615040 = 4851 : 18 : 4

l. s. d.

Answer, 4851 : 18 : 4 very near, as by the
Operation.

C c 2

And

And that there may be nothing wanting to make this Book as perfect, and beneficial to all Gentlemen in their sundry Capacities, I have here inserted, out of Dr. Newton's *Scale of Interest*, a Table that will prove very ready and useful, for the casting up and proportioning Fines, in the renewing of Leases, held from Cathedral Churches, and Colleges in the Universities, as shall be made manifest by the Manner of solving the two following Questions.

Question the First.

If a College-Tenant hath 7 Years yet to come, or unspent in a Lease of Lands for 21 Years, at 1*l.* yearly Rent, and desires to have 14 Years renewed, or added to those seven Years, and so to take a new Lease for 21 Years, to begin presently, what must he pay for a Fine?

Answer, 3 *l.* 3 *s.*

From 7.77507 (being the Number which answers to 21 Years in this 6th Table) subtract always the Tabular Number, which belongs to the Number of Years to come or unspent in the old Lease; so the Remainder will shew, what Fine must be paid for the Years to be renewed or added, to make those unspent Years in the old Lease to be 21 Years compleat again, at one Pound yearly Rent.

So to solve the Question proposed.

From the present worth of 1 <i>l.</i> yearly	}	7.77507
Rent for 21 Years which is		
Subtract the present worth of the same	}	4.62540
Rent for 7 Years (that were unspent in the old Lease.)		
And there will remain the Fine sought,	}	3.14967
to wit		
		That

l.
That is to say, 3.14967
or 3 *l.* 3 *s.* 0 *d.* (very near)
must be paid as a Fine,
for renewing or adding
14 Years to 7 Years, that
were unspent in the old
Lease, the yearly Rent being
1 *l.* also the said 3.14967
shews that such a Renewal
is worth 3 Years Purchase,
and near $\frac{1}{2}$ Parts of a
Year's Purchase, whatever
the Rent be.

Question the Second.

If a Tenant that hath
17 Years yet to come in a
Lease of Lands, held of
a College for 21 Years, at
50 *l.* yearly Rent, be desi-
rous to renew 4 Years,
and so make those 17 Years
to be 21 Years again com-
pleat, at the same Rent,
what must he give for a
Fine?

Answer 23 *l.* 17 *s.* 2 *d.* 1 *f.*

Table the 6th.
Shewing the present Worth
of one Pound Annuity,
for any Number of Years
under 22, at the Rate of
11 *l.* 11 *s.* 8 *d.* 1 $\frac{1}{8}$ *f.*
per Cent. Compound-
Interest.

Years.	Present Worth.
1	0.90034
2	1.69938
3	2.41922
4	3.06438
5	3.64262
6	4.16088
7	4.62540
8	5.04176
9	5.41496
10	5.74948
11	6.04934
12	6.31819
13	6.55907
14	6.77507
15	6.96868
16	7.14226
17	7.29786
18	7.43737
19	7.56243
20	7.67455
21	7.77507

For according to the Rule before given.

From the present Worth of 1 l . yearly } 7.77587
Rent for 21 Years.

Subtract the present Worth of the same } 7.29716
Rent for 17 Years, that were unspent }
in the old Lease

And there will remain 0.47721
Which multiplied by the Rent 50

23|86050

The Product will be the Fine sought to wit,
23 l . 17 s . 2 d . 1 f .

Questions of this Nature may be readily solved, without the Loss of $\frac{1}{16}$ Part of a Years Purchase, by the Help of the foregoing Table the Seventh, for the Benefit of such as understand not Decimal Fractions.

As for EXAMPLE.

If a College-Tenant desireth to have ten Years added to eleven Years, that are yet to come or unspent in a Lease, that may make up his Lease to 21 Years, he must give for a Fine one Years Purchase, and 2 Quarters of a Year's Purchase, and 3 Quarters of a Year's Purchase.

Supposing the Rent to be 48 l . per Ann. the Fine may be computed thus :

TA-

TABLE the 7th.

Years.		Years Purchase.	Quarters of a Quarter.	Quarters of a Quarter.
The Fine for renewing or adding	1 to 20	is valued at	{	0 : 0 : 1
	2 to 19			0 : 0 : 3
	3 to 18			0 : 1 : 1
	4 to 17			0 : 1 : 3
	5 to 16			0 : 2 : 2
	6 to 15	is valued at	{	0 : 3 : 0
	7 to 14			1 : 0 : 0
	8 to 13			1 : 0 : 3
	9 to 12			1 : 1 : 3
	10 to 11			1 : 2 : 3
	11 to 10	is valued at	{	2 : 0 : 0
	12 to 9			2 : 1 : 1
	13 to 8			2 : 2 : 3
	14 to 7			3 : 0 : 2
	15 to 6			3 : 2 : 1
	16 to 5	is valued at	{	4 : 0 : 2
	17 to 4			4 : 2 : 3
	18 to 3			5 : 1 : 1
	19 to 2			6 : 0 : 1
	20 to 1			6 : 3 : 2

l. s. d.
 One Year's } 48 : 0 : 0
 Rent is
 Half a Year's } 24 : 0 : 0
 Rent.
 Three Qtrs }
 of a Quarter
 of a Year's } 9 : 0 : 0
 Rent.

The Sum is
 the Fine re- } 81 : 0 : 0
 quired

Whence it appears,
 That the Tenant must
 give 81 l. as a Fine, for
 adding of 10 Years to
 11 Years, that were ex-
 pired in this old Lease,
 to the end he may have
 a new Lease for 21
 Years compleat.

In like Manner,
 the Fine for renewing
 7 Years to 14, that are
 unspent in a Lease of
 Lands, to the End there
 may be a new Lease
 for 21 Years in being,
 is valued at one Year's
 Purchase precisely,
 which is the fundamen-
 tal Proportion assumed
 in calculating the said
 Table the Sixth, as be-
 fore was said.

The like may be done for renewing any other
 Term of Years under 21, at any Rent proposed.

*An Explication or Meaning of such
Notes or Characters, which for Bre-
vity sake, are used in the ensuing
Questions.*

CHaracters, are Marks, Signs, Notes, or Symbols of Things invented by Artists, and peculiar to several Sciences, by which the Knowledge of Things themselves is always most expeditiously, and most times more clearly, conveyed to the Learner, especially after he hath entred himself to them.

Characters used by Arithmeticians, are chiefly these that follow;

+ *Addition* is thus noted, signifying, that the Number which followeth such Sign is to be added to the Number preceding it; so $4+8$ implieth that 8 is to be added to 4, 'tis called the affirmative and positive Sign, and is directly contrary to the following Sign.—

— Is the Note of Negation, or *Subtraction*, signifying that the Number which followeth such Sign, is to be subtracted from the Number preceding it; so $8-5$ signifieth the Difference between 8 and 5, or 5 to be subtracted from 8.

X Is the Character of *Multiplication*, and signifieth, that the Numbers, between which it is placed, are to be multiplied together, as 7×4 signifieth, that 7 and 4 are to be multiplied together.

= This

$=$ This Character is a Sign of Equality, and is universally used for equal to, as $3+6=7+2$ signifieth, that 3 and 6 are equal to 7 and 2; also $5+9=14$; likewise $18-6=4+8=12$.

$>$ This Character is a Sign of Majority, signifying that the Number on the Left-hand of such Sign, is less than the Number on the Right-hand thereof; so $5>3$ implieth, that 5 is greater than 3

$<$ This Character is the Sign of Minority, signifying that the Number on the Left-hand of such Sign, is less than the Number on the Right-hand thereof; so $3<5$ implieth, that 3 is less than 5.

$\sqrt{}$ This Character or $\sqrt{q}$. signifieth the Square-root of the Number which followeth it, so $\sqrt{144}$ implieth the Square-root of 144, to wit 12.

$\sqrt[3]{}$ This Character signifies the Cube-root of the Number which followeth it; so $\sqrt[3]{1728}$, signifies the Cube-root of 1728, which Cube-root will be found to be 12.

$\div$ Is the Character of *Division* thus, $12 \div 8$ signifieth, that 12 is to be divided by 8: Some Authors express it thus $8)12$ (—

$::$ Is the Character for Arithmetical Proportion.

$::$ Is the Character of Geometrical Proportion disjunct, and is usually placed between two Pair of Proportionals, as in the Rule of 3; thus $4.6 :: 8.12$, and shews that 4 hath the same Proportion or *Ratio* to 6; that 8 hath to 12.

What

What is meant by Proportion.

1. Proportion is first, when two Quantities are compared one with another, in respect of their Greatness or Smallness ; that Comparison is called, *Ratio*, Reason, Rate, or Proportion : But when more than two Quantities are compared, then the Comparison is more usually called the Proportion they have to one another.

2. If of four Numbers given, the first be to the Second, as the Third is to the Fourth ; these four are called proportional Numbers.

3. Therefore, if four Numbers be Proportional, the Product of the Means, is equal to the Product of the Extreams : So these Numbers following are called Proportionals, viz.

$$4 \times 6. \quad 6 :: 4 \times 9. \quad 9$$

$$\frac{2}{3} \times 12. \quad 12 :: \frac{2}{3} \times 15. \quad 15$$

That is to say, 4 times 6 (or 24) is said to have such Proportion to 6 ; as 4 times 9 (or 36) hath to 9. In like Manner, $\frac{2}{3}$ of 12 (or 8) hath such Proportion to 12, as $\frac{2}{3}$ of 15 (or 10) hath to 15 ; from hence ariseth the *Rule of Three* ; or for the Excellency thereof, is called the *Golden-Rule*. These Things being premised, understood, and remembred, I proceed to the Solution of Choice and Select Questions.

C H A P,

C H A P. XXVIII.

Questions.

A Collection of pleasant and subtil Questions, to exercise all the Parts of Vulgar Arithmetick, both in whole Numbers and Fractions; to which are added practical Questions about the Mensuration of superficial Figures and Solids.

Examples of the Rule of Three mixtly used.

Quest. 1.  Grocer will bestow 183 l. viz. in Cloves at 4 s. 2 d. per lb. Macé at 7 s. 6 d. Cinamon at 3 s. 8 d. Nutmegs at 12 s. 3 d. and Pepper at 2 s. 10 d. per lb; and he would have as many Pounds of one Kind as of another: The Question is, to know how many Pounds must he have?

Answer, 120 lb. 1 oz.

s.	d.	l.	s.	d.	lb	l.
4	: 2	1	: 10	: 5	buy 1	— 185
7	: 6					
3	: 8					
12	: 3					
2	: 10					
1	: 10	: 05				

d.	Or,	d.
365	lb	43920
	— 1 —	— 02.
365	) 43920	(120. $\frac{120}{365} = 1. \frac{120}{365}$

Quest.

Quest. 2. *A, B, C, and D, have 100 l. Sterling, to be divided amongst them, in such Sort, that as oft as A. hath 3 l. B. must have 5 l. and as oft as B. hath 5 l. C. must have 7 l. and as oft as C. hath 7 l. D. must have 10 l. what must each have?*

Add the Proportionals into one Sum.

$$\begin{array}{l} \text{Thus } \left\{ \begin{array}{l} 3 \\ 5 \\ 7 \\ 10 \end{array} \right\} \text{ Then if } \left\{ \begin{array}{l} 25 : 100 :: 3 \\ 25 : 100 :: 5 \\ 25 : 100 :: 7 \\ 25 : 100 :: 10 \end{array} \right\} \begin{array}{l} 12 \text{ A.} \\ 20 \text{ B.} \\ 28 \text{ C.} \\ 40 \text{ D.} \end{array} \\ \hline 25 \qquad \qquad \qquad \text{Proof } 100 \end{array}$$

Quest. 3. *If 60 Gallons of Water do in 1 Hour's Time fall into a Cistern containing 200 Gallons, and by a Pipe in the same Cistern, there run out 45 Gallons in the Hour, how many Hours will it be before 'tis filled.*

Answer, in 13 Hours and 20 Minutes.

	Gall.	Hours	Gall.
60 filling Cock	15	1	200
45 empties		<i>b.</i>	
	15	200	$(13\frac{1}{3}) = 20 \text{ Minutes.}$
15 Diff.	15		
	50		
	45		
	5		$13\frac{1}{3}$

Quest. 4. *Two Footmen, A. and B. depart from one Place, and both go one Road, but A. goes 3 Days before B. and travels 30 Miles a Day, B. follows after, and travels 50 Miles a Day, in how many Days travel will B overtake A?*

B. 50.

Questions.

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$$\begin{array}{r} B. 50 \\ A. 30 \\ \hline \end{array}$$

20 Excess. 90 Miles which A. hath travelled at B's setting out.

M D. M.

Then if 20 : 1 :: 90

Answer, B. will overtake him at the End of 4 Days, and a half, and will have travelled 225 Miles.

$$20)90(4 \frac{1}{2}$$

80

10

For 50.

By $4 \frac{1}{2}$

200

25

225 Miles.

Quest. 5. If 20 Sheep feed in a Pasture 40 Weeks for 10 s. how many Sheep for 15 l. for 12 Weeks, can I put into the same Pasture?

s. Sheep s.

If 10 : 20 :: 300

20

6000

W. Sheep W.

Then if 40 : 600 :: 12

40 Indirect

Rule of 3.

12)24000(2000

Sheep.

150)6000(600 Sheep.

Answer, 2000 Sheep.

Quest 6. A Herring and a half for 3 Half-pence, how many for 11 Pence?

1 d. $\frac{1}{2}$

d. Herring

1. $\frac{1}{2}$ buy 1. $\frac{1}{2}$ what will 11

$$\begin{array}{r} 4 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 3 \end{array}$$

$$\begin{array}{r} 4 \\ \hline 44 \\ 3 \end{array}$$

2)

6)132(22(11 Her^r
(rings.

o o

132

Question 7. When 120 Oranges are bought at 2 a Penny, and 120 Oranges at 3 a Penny, and put together and sold 5 for 2 Pence, what is gained or lost?

Answer 4 d. lost.

$$\begin{array}{r} \text{Or.} \quad d. \\ 2 \text{ --- } 1 \end{array} :: 120$$

Answer, 5 s.

$$\begin{array}{r} \text{Or.} \quad d. \\ 3 \text{ --- } 3 \end{array} :: 120$$

Answer, 3 s. 4 d.

Then sell them together.

$$\begin{array}{r} \text{Or.} \quad d. \\ 5 \text{ --- } 2 \end{array} :: 240$$

Answer, 8 s.

8 : 4 the Oranges cost
8 : o Sold for.

o : 4 Pence lost.

Quest. 8. A Draper gave 155 l. for 17 Cloths at Blackwell-hall, how must he sell by the Piece, to gain 10 l. per Cent.

$$\begin{array}{r} l. \\ 100 \text{ --- } 10 \end{array} :: 155$$

Answer, 15 l. 10 s.

Cloths	l.	s.	Cloth	l.	s.	d.
Then 17	170	10	1	155	00	0
				15	10	0
				170	10	0

Answer, 10 : 0 : 7. $\frac{1}{17}$

Quest. 9.

Questions.

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Quest. 9. If a Wedge of Gold weighing 17 lb. $\frac{7}{8}$ of Troy-weight, be worth 679. $\frac{1}{2}$ l. Sterling, what is the Value of 1. $\frac{1}{3}$ Grain of that Gold. Answer, 2 d.

First, $1. \frac{1}{3}$, ($\frac{1}{3}$ of $\frac{1}{24}$ of $\frac{1}{2}$ of $\frac{1}{12} = \frac{1}{48}$ of $\frac{1}{8}$.

Secondly, $\frac{1}{7} \dots \dots \frac{42 \frac{1}{2}}{7} :: \frac{1}{12} = 2 d.$

For 20 is $\frac{1}{2}$ of $\frac{1}{12}$

$$\begin{array}{r} 12 \\ \hline 240 \end{array}$$

d.

120)140(2 for Answer.

Quest. 10. A Man dying, gave to his eldest Son $\frac{2}{3}$ of $\frac{1}{4} = (\frac{1}{6}$ of his Estate; to his second Son $\frac{1}{3}$ of $\frac{1}{4}$ ($= \frac{1}{12}$) and when they had counted their Portions, the one had 40 l. more than the other; the Remainder of the Estate was given to the Wife and younger Children, I would know, what was the Portion of the eldest Son, also of the second, and how much did belong to the Wife and younger Children?

Answer, The eldest Sons Portion 100
The second Son's Portion 60
And 440 l. for the Wife and Children.

Thus found,

$$\frac{6}{60} - \frac{1}{60} = \frac{5}{60} = \frac{1}{12}$$

(Portion.

Then If $\frac{1}{12}$, $\dots \dots \frac{40}{12} :: \frac{1}{12}$ ($\frac{40}{12}$ the second Son's

The Difference of their Portions being 40 l. therefore by Consequence, the eldest Son's Portion must be 100 l.

Then to find out the Wife and younger Childrens Portions

say,

$$\text{If } \frac{1}{12} \dots \dots \frac{40}{12} :: \frac{1}{12} (\frac{40}{12})$$

Lastly, $600 - 160 = 440$ l. that is to say, take 160 l. out of 600 l. and there will remain 440 l. for the Wife and younger Children.

• **Quest. 11.**

Quest. 11. A young Merchant receiv'd 66 $l. \frac{1}{3}$ which was $\frac{2}{3}$ of $\frac{1}{2}$ of his elder Brother's Portion, was $1 \frac{1}{4}$ times of his Father's Estate, the Question is, what was the Father's Estate? Answer, 560 $l.$

1. If $\frac{1}{3} - - - - - 66 \frac{1}{3} :: \frac{1}{4}$ (200 $l.$ the elder Brother's Portion.

2. $200 \times 3 \frac{1}{2} = 700$

For

200

7

(2(1400(700

1400

Then

If $1 \frac{1}{4} - - - - - 700 :: \frac{1}{4}$ (560 $l.$ the Father's Estate.

Quest. 12. Two depart from one Place, the one Eastward and the other Westward, the one travel-
leth 3 Miles a Day, and the other 5 Miles a Day,
how far are they distant the ninth Day after their
Departure? Answer, 72 Miles.

Here their first Days Distance is added together,
which makes 8, and then it is $1 - - - 8 :: 9$ (72

Quest. 13. There are 30 Cloths bought for 70 $l.$ and
are sold for 80 $l.$ Now if they had cost 80 $l.$ how
should they have been sold to have gained after the
same Rate? Answer, 91 $l. 8 s. 5 d.$

If 70 Stock—80— :: 10

10

70)800(11 - $\frac{10}{70} = 8 - 5$

70

140

70

30

Thus, 80+11 - 8 - 5

91-08

Quest. 14

After the same Manner this Question is performed.

Quest. 16. A Drunkard drinketh a Barrel of strong Beer in 14 Days, but when his Wife drinketh with him, he drinketh it out in 10 Days, in what Time would his Wife drink it out alone?

Answer, 35 Days.

	Days	Days	Days
14	Then if 4	give 10	what will 14
10			
4			
			140
			4)140(35 Days.

Quest. 17. What is the $\frac{1}{8}$ Part of a Ship worth, when the $\frac{1}{2}$ is valued at 1015 l . — 40s?

Answer 253 l . 5 s.

$$1015 - 2 = 1013$$

$$\frac{1}{2} - \frac{1}{8} = \frac{3}{8} :: \frac{1}{8}$$

$$\text{l. } 5 \text{ s.}$$

$$8)2026(253. \frac{3}{8} = \frac{1}{4} = 5$$

Quest. 18. There is a Ship to be fitted out for 60 Men, to the *West-Indies*, and victualled for a Year (52 Weeks or 365 Days) and each Man is to be allowed $\frac{1}{4}$ of a Gallon of Beer a Day, and 7 Biskets. There are every Week 2 Beef-days, 2 Pork-days, 3 Fish-days, 7 lb . of Beef is allowed amongst 4 Men, every Beef-day, 7 lb . of Pork every Pork-day, and 2 Quarts of Pease; $\frac{1}{3}$ of a Ling, 2 Ounces of Butter, and $\frac{1}{4}$ lb . of Cheese every Fish-day.

Now

Questions.

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Now what Provisions must be laid in of each Sort, and what will the Provisions amount to at the following Rates?

Beer 40 s per Tun.

Beef 22 d. per Stone.

Biskets 2 s. 8 d. per C. 112 lb. to the Hundred.

Fish 1 s. 9 d. per Couple.

Butter 12 s. per Firkin, the Firkin 56 lb Weight.

Cheese 1 l. 2 s. per C. at 112 lb. to the Hundred.

Pork 1 s. 4 d. per Stone, 8 lb. to the Stone.

Pease, 2 s. 6 d. per Bushel.

Answer.

		l.	s.	d.
Beer	65 Tuns, 45 Gallons	130	07	01
Biskets	1368 Hundred-weight	182	08	00
Beef	1365 Stone	125	02	06
Pork	1365 Stone	91	00	00
Pease	97 $\frac{1}{2}$ Bushels	12	03	09
Ling	936 Couple	81	18	00
Butter	20 Firkins	12	10	08
Cheese	20 C. 3 qrs. 16 lb.	22	19	07
		658	09	07

This Ship carries 28 Pieces of Ordnance, viz.

- 3 Demi-culverins of 16 lb. Bullet.
- 4 Whole Culverins of 12 lb.
- 6 Demi-Culverins— 10 lb.
- 8 Sakers ——— 7 lb.
- 3 Falcons ——— 4 lb.
- 2 Faulconets ——— 1 $\frac{3}{4}$ lb.
- 2 Minion Cuts ——— 1 $\frac{1}{2}$ lb.

Question the 18th continued.

How many Pounds of Powder will discharge these Pieces 50 times over, when to shoot a Bullet of 1 lb. weight, there is allowed $\frac{1}{2}$ a Pound of Powder; Now what doth the Powder amount to, at 4 l. 7 s. 6 d. per C.

Answer, 5762. $\frac{1}{2}$ Pounds of Powder, to discharge these Pieces 50 times over, and the Powder at 4 l. 7 s. 6 d. per C. amounts to 225 l. 1 s. 11 d. $\frac{4}{11}$.

Thus found, as by the Operations.

Beer,	
3 Quarts.	
60 Men.	
180 Quarts per Day.	
365	
900	
1080	
540	
63	4 Tuns Gall.
4)65700(16425(260(65 : 45	
126	24
382	20
378	20
45	

Question

Questions.

405

Question the 18th continued.

Biskets.

$$\begin{array}{r}
 7 \\
 60 \\
 \hline
 420 \text{ Biskets a Day.} \\
 365 \\
 \hline
 2100 \\
 2520 \\
 1260
 \end{array}$$

Stone

$$112)153300(1368 : \frac{1}{4}$$

84

Beef.

$$\begin{array}{r}
 \text{Men} \quad \text{lb.} \quad \text{Men} \\
 4 \text{ --- } 14 \text{ --- } 60 \\
 14 \\
 \hline
 240 \\
 60
 \end{array}$$

Stone

$$4)840(210 \text{ Beef 1 Week.}$$

52

420

1050

10920 Beef.

$$8)10920(1365$$

Stone

The like Quantity for Pork, 1365 Stone.

D d 3

Que-

Questions

Question the 18th continued.

Pease.

$$\begin{array}{r} \text{Men} \quad \text{Quarts} \quad \text{Men} \\ 4 \text{ --- } 4 \quad :: \quad 60 \end{array}$$

4

$$\begin{array}{r} 8 \text{ Bushels} \quad \text{---} \quad 4)240(60 \\ 4)3120(780(97. \frac{1}{2} \quad \text{---} \quad 52 \\ \quad \quad \quad 72 \quad \quad \quad \text{---} \end{array}$$

60

156

4

 $\frac{4}{8} | \frac{3}{4} | \frac{1}{2}$

120

360

3120 Quarts:

Ling.

One Fifth every Fifth-day amongst 4 Men: There are three Fish-days, per Week?

$$\frac{1}{5} \times \frac{4}{1} = \frac{4}{5}$$

$$\frac{4}{5} \times \frac{1}{1} = \frac{4}{5}$$

Men

Men

4

12

60

12

5

20

12

Fish for 1 Week.

60

4

Week

Fish

Weeks

720 Num. 20 Denom.

1

36

::

52

Couple

2)1872(936

312

156

(Ling!

1872 whole

Que-

Question the 18th continued.

Butter.

Two Ounces of Butter each Day to 4 Men,
there are 60 Men.

oz.

1

4

8

3

24 Ounces each Day.

Men

oz.

Men

4

24

60

4)1440(360 Ounces in one Week.

Week

oz.

Weeks

1

360

4

52

720

1800

56

Firk. lb.

16)18720(1170(20 : 50

50

dd 4

Question

Question the 18th continued.

Cheese.

One Fourth of a Pound of Cheese every Fifth-day,
amongst four Men there are 60 Men.

$$\frac{1}{4} \times \text{by } \frac{1}{5} = 1$$

$\frac{1}{3}$ Fifth-days

$\frac{1}{3}$ l. each Fifth-day.

Men l.

4 ——— 3 :: 60 Men (45 Pounds of Cheese
(a Week.

45

52

C. grs. lb.

grs. lb. 112)2340(20.3 : 16 Cheese.
 $\frac{112}{112} = 3 : 16$

100

As for the Powder. Vide the Question.

lb.		lb.		Then 230 $\frac{1}{2}$
16	X	3	=	48
12	X	4	=	48
6	X	10	=	60
8	X	7	=	56
3	X	4	=	12
2	X	1 $\frac{1}{2}$	=	3 $\frac{1}{2}$
2	X	1 $\frac{1}{2}$	=	3

1 Powder $\frac{1}{2}$ lb. ——— 11525

Total ——— 230 $\frac{1}{2}$

They shoot 230 lb. $\frac{1}{2}$
at one Shooting.

2)23050(11525(5762. $\frac{1}{2}$ of
Powder to dis-
charge the Guns 50 times over.

Then

Questions.

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Then for the Cost and Price.

$$112 \text{ l. } 4 \text{ s. } 7 \text{ d. } 6 \text{ far.} :: 5762 \text{ l. } \frac{1}{2}$$

$$112 \text{ Pence } 1050 :: 5762 \text{ l.}$$

Answer, 225 l. 1 s. 11 d. $\frac{1}{2}$.

Quest. 19. In Arithmetical Progression.

1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 — *Arith. Proport.*
2 . 4 . 8 . 16 . 32 . 64 . 128 . 256 — *Geo. Proportion.*

Weeks.

A certain Mercer sold 20 Yards of Velvet, to be paid for in 12 Weeks, by Arithmetical Progression; that is, to wit, to receive the first Week 6 s. the second 12 s. the third Week 18 s. and so forward, increasing the Number of Weeks by six Shillings, till the twelfth and last Week were expired; the Question is, how many Pounds he must have for his 20 Yards of Velvet?

6	1
12	2
18	3
24	4
30	5
36	6
42	7
48	8
54	9
60	10
66	11
72	12
6 add the	
1st Num.	
78 ber.	

Then multiply the Number of Places by your first Number, and it gives you your Answer in Shillings.

$$\begin{array}{r} 78 \\ 6 \\ \hline 468 \text{ Shill.} \\ \hline 338 \end{array}$$

Answer, 23 l. 8 s.

Quest.

Quest. 20. One hundred Stones are so placed, every one a Yard distant from another, and one Yard distant from a Basket, how many Miles must he run to take up the Stones, one after another, still returning to the Basket and putting them in?

Here the first, third, and fourth Terms, are given to find out the fifth

By this general Rule, from the Product of the third, into the fourth, subtract the 4th, and to the Remainder add the Double of the first, half the Product of that Sum multiplied by the third, gives the fifth for Answer.

The third 100

Or

The fourth 2 $200 + 2 = 202$

The fourth 2

Rest 198

Double of the 1st 4

Multiplied by

the 3d gives $20200 = 10100$ Yards.

And 10100 Yards divided by 1760 gives in the Quotient 5.44 Miles, which is exactly $\frac{1}{4}$ — 8 of a Mile.

Geometrical Progression.

Quest. 21. Suppose I sold a Horse after this Manner, the Horse had four Shooes, in every Shoe there were six Nails, in all 24 Nails; and he was content to pay a Half-penny for the first Nail, and double it to the last, what ought he to pay for the Horse?

See the Work plainly demonstrated.

1	1	The whole Process of the Question is plainly set forth, by setting down the Number of Nails, and increasing in a Geometrical Proportion, by doubling each Number; I find at last, it amounteth unto 16777216 Half-pence, and by abating always the first Number which is here, 1 it is 16777215 Half-pence, which being reduced into Pounds, Shillings, and Pence, it maketh 34952 <i>l.</i> 10 <i>s.</i> 7 <i>d.</i> $\frac{1}{2}$ at a Half-penny per Nail, 17476 <i>l.</i> 5 <i>s.</i> 3 <i>d.</i> $\frac{1}{4}$ at a Farthing a Nail.
2	2	
4	3	
8	4	
16	5	
32	6	
64	7	
128	8	
256	9	
512	10	
1024	11	
2048	12	
4096	13	
8192	14	
16384	15	
32768	16	
65536	17	The last Sum 8388608 multiplied by 2, the Product will amount unto 16777216, from which subtract the first Number 1, and then it is 16777215.
131072	18	
262144	19	
524288	20	
1048576	21	
2097152	22	
4194304	23	
8388608	24	

Quest.

Questions.

Quest. 22. Suppose a Footman, *A.* running every Day 40 Miles, is pursued the fourth Day, after, by another (suppose *B.*) 50 Miles a Day; in how many Days, and after how many Miles Travel will *A.* be overtaken? Answer, at the End of 12 Days.

Subtract 40 from 50, rest 10 Miles, the clear Gains of 1 Day; but because *A.* was gone 3 Days Journey before *B.* set out, that is 120 Miles before *B.* pursued. Then say,

$$\begin{array}{rclcl} \text{Miles} & & \text{Day} & & \text{Miles} & & \text{Days} \\ \text{If } 10 & \text{---} & 1 & :: & 120 & \text{---} & 12 \\ & & 10 & & 120 & & 12 \end{array}$$

$$\begin{array}{rclcl} & & \text{Day} & & \text{Miles} & & \text{Days} & & \text{Miles} \\ \text{Then say, If } 1 & \text{---} & 50 & :: & 12 & & (600 \\ & & 12 & & & & \\ & & & & 600 & & \end{array}$$

600 Miles that *B.* must go, before *A.* be overtaken.

Quest. 23. A Merchant would bestow 160 *l.* in Cloves, Mace, and Nutmegs; the Cloves at 4 *s.* per *lb.* Mace at 12 *s.* per *lb.* and Nutmegs at 6 *s.* the Pound; now he would have of each Sort an equal Quantity, how many Pounds must he have of each Sort? Answer, 236 *l.* 5 *oz.* $\frac{1}{2}$

$$\begin{array}{rclcl} \text{s.} & & \text{s.} & & \text{lb.} & & \text{l.} & & \text{lb.} & & \text{oz.} \\ 4 & & 22 & & 1 & :: & 160 & & 22)5200 & & (236:5.1\frac{1}{2} \\ 12 & & & & 20 & & 44 & & & & \\ 6 & & & & & & 80 & & & & \\ \text{---} & & & & 5200 & & 66 & & & & \\ 22 & & & & & & 140 & & & & \\ \text{---} & & & & & & 132 & & & & \\ & & & & & & 8 & & & & \end{array}$$

Quest.

Questions.

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Quest. 24. A Merchant gave to four Beggars 20 s. viz. to A, B, C, D; to A $\frac{1}{3}$, to B $\frac{1}{4}$, to C $\frac{1}{5}$, and to D $\frac{1}{6}$?

Here according to the Question.

A. had	6 : 8	But the Sum to be paid
B. had	5 : 10	ought to be 20 s. there-
C. had	4 : 0	fore 12 d. or 1 s. must be
D. had	3 : 4	divided into such Proportion,
		as the Parts bear to
Sum	19 : 0	one another.

Wherefore reduce the Fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, to $\frac{1}{60}$, into a common Denominator, and they will be $\frac{20}{60}$, $\frac{15}{60}$, $\frac{12}{60}$, $\frac{10}{60}$, and neglecting the common Denominator, add the Numerators into one Sum, which will be 57; then the Proportion is,

As $\frac{12}{1}$ to $\frac{20}{1}$	::	so 20 : to 6 : 8	$\frac{20}{37}$	20
		15 : to 5 : .	$\frac{15}{37}$	15
		12 : to 4 : .	$\frac{12}{37}$	12
		10 : to 3 : 4	$\frac{10}{37}$	10
		add 1		
				57(1
		Proof 20 : 0	Fra ^t . = 1 s.	

Quest. 25. Two Men A. and B, discoursing of their Money; A. says to B. if I had two of your Pieces, I should have twice as many as you have; to which B. replies, if I had two of yours, I should have just as many as you have, how many had each?

Answer. { A. had 14
 { B. had 10

Suppose A. had 16, to which, 2 being added, makes 18, which is twice 9; but having taken 2 from

from thence, it must be by this Supposition that *B.* had 11; wherefore 2 taken from 16, and added to 11 makes 13, for *B.* and *A.* 14, therefore the Error too much by one.

For my second Supposition.

Suppose *A.* had 20, then $20 + 2 = 22$, that is, twice 11; but from thence 2 being taken *B.* must have 13. Now 2 from 20, and put to 13 gives 15 for *B.* and leaves 18 for *A.*, which is not equal, therefore the Error again too much by 3.

The Operation.

$$\begin{array}{r} 48 \quad 28 \quad 20 \\ 16 - 20 \\ \hline X \quad (14 \text{ } A. \\ 1 \quad 3 \\ 2 \end{array}$$

So that *A.* had 14 and *B.* 10.

P R O O F.

$$\begin{array}{l} 14 + 2 = 16 \\ 10 - 2 = 8 \end{array} \left. \vphantom{\begin{array}{l} 14 + 2 = 16 \\ 10 - 2 = 8 \end{array}} \right\} \text{half.}$$

$$\begin{array}{l} 14 - 2 = 12 \\ 10 + 2 = 12 \end{array} \left. \vphantom{\begin{array}{l} 14 - 2 = 12 \\ 10 + 2 = 12 \end{array}} \right\} \text{equal.}$$

Quest. 26. A Man gave away his Estate in this Manner, to *A.* $\frac{1}{2}$ and he gave back 10 *l.* to *B.* $\frac{1}{3}$ and he gave back 6 *l.* to *C.* $\frac{1}{4}$ and he gave back 4 *l.* last of all he had 16 *l.* remaining, I demand his Estate?

Answer, 48 *l.*

For

Questions.

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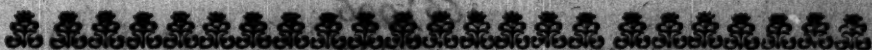
For according to the Question. $\left\{ \begin{array}{l} A. \text{ had } 14 \\ B. \text{ had } 10 \\ C. \text{ had } 8 \end{array} \right.$

Answer, 32.

In all $\underline{32}$ and 16 left

$\underline{32}$

which makes 48



 *A few Propositions in Military Orders, as to the Use of the Square-Root.*

Examples of the Extraction of Roots.

Quest. 27. To place any Number of Soldiers, (suppose 36000) in such Order of Battle, that there shall be any Number in Rank or File: suppose 500 in Rank, how many must there be in File?

Answer, 72.

R U L E.

Divide the whole Number of the Army (36000,) by the assigned Men in Rank or File, the Quotient will be your Answer, and is the Number that will be in File or Rank.

500)36000(72 Men
3500

1000

1000

Quest.

Quest. 28. If 7396 Soldiers are to be placed in a square Battle, how many are to be set in Rank or in File?

Answer, 86.

For the Square-Root of
7396 is 86.

7396(86 Soldiers.

64

166)996

996

Quest. 29. Suppose 61504 Soldiers were to be placed into a Square Battle?

Answer, 248 Men.

61504(248 Square-Root.

4

44)215

176

488)3904

3904

00

Quest. 30. Admit 16928 Men were to be put in to a double Battle?

R U L E.

Extra~~d~~ the Root of half the Number of Men, that is, 8464, whose Square-Root is 92: Therefore I say, that 92 Men must be placed in File, and 184 in Rank, to order that Number of Men into a double Battle.

8464

Questions.

417

8464(92 Men, is the Square-root, and 184 Men in Rank to make up the double Battel.

$$\begin{array}{r} 182 \overline{)364} \\ 364 \\ \hline 0 \end{array}$$

$$\text{For } 92 + 92 = 184$$

Quest. 31. Again, Suppose 1342 Soldiers were to be put into a double Battel, I find 26 ought to be placed in File, and 52 in Rank?

$$1342(671$$

$$671(26$$

$$4$$

$$46)271$$

$$276$$

(Square.

5 odd Men wanting to make the

Quest. 32. To order any Number of Soldiers into a Battel of the grand Front?

The Rule is here: For the Square-Root of the $\frac{1}{4}$ Part of the Number given, will shew the Number to be placed in File, and four times so many are to be placed in Rank.

So 16900 Soldiers being to be put into that Order, extract the Square-root of 4225 for that is the $\frac{1}{4}$ of 16900, the Square-root is 65; therefore 65 must be placed in File, and 260 in Rank, to form a Battel of the Grand Front.

$$125)625$$

$$625$$

$$65 + 4 = 260 \text{ Men in Rank.}$$

Ec

Quest.

Quest. 33. Any Number of Men, together with their Distance in Rank and File, being propounded, to order them into a Square Battel of Ground?

Admit 2500 Soldiers were to be placed into a Square Battel of Ground in such sort, that their Distance in File should be 7 Foot, and in Rank 3 Foot; and 'tis required to know how many Men must be placed in Rank and in File, to draw up 2500 Men into a Square Battel of the Ground: Then say,

As $7-3 :: 2500(1071.7)$
Whose Square-root is 32

therefore I say, 32 Men are to be placed in File.

Now to find how many Men are to be placed in Rank, divide 2500 by 32, the Quotient is 78, which is the Number of Men to be placed in Rank, and 4 Men to be disposed of else where.

$32)2500(78$ Men in Rank, and 4 odd Men
to be disposed of.

$\begin{array}{r} 260 \\ 256 \\ \hline 4 \end{array}$

Quest. 34. Any Number of Soldiers propounded, to order them in Rank and File, according to the Ratio of any two Numbers given?

Admit 6400 Soldiers are to be put in Array, in such Order, that the Number of Men placed in File, shall bear such Proportion to the Number in Rank as 7 is to 13.

$7-13 :: 6400(1188.5)$

Whose Square-root is 109, &c. the Number of Men to be placed in Rank, by which divide 6400,

Questions.

419

it produces 58, the Number of Men to be placed in File, and 78 Men to be employed elsewhere.

Operation.

$$7 \text{ --- } 13 :: 6400$$

13

Quest. 34. The circumference of the Circle-top is 120 feet, find out a Proportion to 6400 like Solid, as Globe.

What a Cube $(58811)00248$ will represent by a

Dye, which is a little Circle, being a Right-

angle, or Square, Solid, that hath an equal Length,

its equal Squares, now is the Side of the Cube,

equal Squares, which is also the Side of the Cube,

be 12 Inches, $(58811)00248$ is the Content, which

Square Inch being multiplied again by 12,

produces 705732 Cubical Inches.

78 Men left. 209) 4 Men left.

Quest. 35. Suppose the Wall of a Castle that is besieged, is in Height 18 Feet, and there is a Moat full of Water, that surroundeth the said Castle, to be 24 Feet broad, what Length must a Scaling-Ladder, have to reach from the outermost Side of the Moat to the top of the Wall?

Answer, 30 Feet (to wit the Square-root of the Sum of the Squares of 18 and 24.)

$$18 \times 18 = 324$$

$$24 \times 24 = 576$$

$$\sqrt{900} = 30$$

Order, is a Term in Military Discipline; being the equal Distance of one Rank or File from another; the usual Order in Files is 3 Foot, and in Ranks 6 Foot; the open Order is double in each.

E c 2

The

Questions.

Thus much shall suffice for the Use of the Square-Root, we will now proceed to some Uses of the Cube root.

Of the Cube-Root.

Quest. 36. The chief Use of the Cube-root, is to find out a Proportion between like Solids, as Globes, Cylinders, Cones, &c.

What a Cube is, may be well represented by a Dye, which is a little Cube it self, being a Rectangular, or Square Solid, that hath an equal Length, Breadth, and Depth, and is comprehended under six equal Squares; now if the Side of one of those equal Squares (which is also the Side of the Cube) be 12 Inches, the superficial Content will be 144 Square Inches, which being multiplied again by 12, produceth 1728 Cubical Inches.

As in these Examples, $\mathcal{M}$ and $\mathcal{M}'$

If a Bullet of Lead of 6 Inches Diameter weigh 88 lb. what will a Leaden Bullet weigh, whose Diameter is 3 Inches.

The Rule.

As the Cube of the Diameter given, is to the Weight thereof, so is the Cube of the Diameter sought to the Weight thereof.

The Work.

C. D.

216—68 :: 27

27

250

476

—602 136

—

2161820

1728

1 3 21 27 17

198

3 9 3



Questions.

421

Quest. If a Bullet, whose Diameter is 9 Inches, do weigh 72 Pounds, what will a Bullet of the same Metal weigh, whose Diameter is 6 Inches?

Answer, 11 lb. $\frac{1}{2}$.

See the Work.

C.D.	lb.	C.D.
9	72	6
9	72	6
81	36	432
9	6	1512

729	216	729	1512
729	216	729	1512
729	216	729	1512
729	216	729	1512
729	216	729	1512

Fractions abbreviated.

$\frac{1}{2} \frac{1}{3} \frac{1}{4} \frac{1}{5} \frac{1}{6} \frac{1}{7} \frac{1}{8} \frac{1}{9} \frac{1}{10}$

Quest. 38. If a Ship of 100 Tun be 44 Foot long at the Keel, of what Length shall the Keel be of a Ship of 220 Tun?

Answer, 57—225 Foot $\frac{1}{2}$ Foot.

44	220	44	220
44	220	44	220
176	4400	176	4400
176	4400	176	4400

1036 Sq.	48400 Sq.	1036 Sq.	48400 Sq.
44	220	44	220
7744	96800	7744	96800
7744	96800	7744	96800

Answer, 57—225 Foot $\frac{1}{2}$ Foot.
85184 Cube. 10648000 Cube

Questions

$$\begin{array}{r} \text{Ton} \quad \text{Cub of 44} \quad \text{Ton} \\ 100 \quad 85 \quad 100 \\ \hline 1703680 \end{array}$$

$$\begin{array}{r} 1703680 \\ 100 \overline{) 18740480} \quad 180 \quad (1874048 \\ \hline \end{array}$$

Whose Cube Root is $57.225 = \frac{4}{3}$, the Length of the Keel sought.

Quest. 39. If the Breadth of a squared Piece of Timber, supposed to be strait and terminated at both Ends by two equal Squares, be 2.55 Foot, the Depth also 2.55 Foot, and the Length 18.5 Feet, how many Cubick Feet are contained in that Piece of Timber?

Thus found.

$$\begin{array}{r} 2.55 \quad 6.5025 \\ 2.55 \quad 18.5 \\ \hline 1275 \quad 322125 \\ 1275 \quad 520300 \\ \hline 6.5025 \end{array}$$

6.5025 superficial Feet which is the Content of the Squares at the End of the Piece.

$$\begin{array}{r} 120.29625 \end{array}$$
 which is the Solid Content required.

Quest. 40. If the Breadth and Length of a squared Piece of Timber, having equal square Bases be 1.75 Foot, how far ought one to measure along the Length of that Piece of Timber, to make a Foot Solid?

Answer, $326 \frac{1}{4}$ or $1 \frac{1}{4}$ Parts of a Foot.

1.75

1.75

875

1-1-1.9090909(1.96)

Concerning the Gauging of Vessels.

THE easiest and aptest Ways for Practise in Gauging, are those which are performed by the Help of Tables, or Gauging-Rods, purposely composed upon sliding Rules of nine Inches, or a Foot long, by which you may take the Dimensions, and for that Purpose are very convenient.

However, not to omit to give the Reader of this Treatise, I shall here insert some Questions, by which the young Gauger may have some Light.

Concerning the Gauging of Brewers Vessels.

Question. 42. To find the Area of any square Tun, Back, or Cooler, either in Ale or Wine Gallons.

R U L E.

Multiply the given Length, or Breadth, into itself, and the Product will be the Area in Inches; then divide that Area by 282, which gives you the Area in Ale-Gallons; and by 231, and the Quotient will give you in Wine Gallons.

As for E X A M P L E.

Suppose the Side of a Square Tun, Back, or Cooler, be 124.5 Inches, what will be its Content in Ale and Wine Gallons?

First,

Gauging

225

First, 1245 multiplied by 2245 gives 2794500
 in the Product
 Then 2794500 divided by 282 gives 9945
 in the Quotient the Area in Ale-Gal 554.96 Inches.
 And 2794500 divided by 231 gives 12100
 the Quotient the Area in Wine-Gal 576.10 Inches.

So that the Answer is for Ale 554.96 Inches
 and for Wine 576.10 Inches.

Note, That the Ale-Gallon contains 282 Cubical
 Inches; and that a Wine-Gallon contains 231 Cubi-
 cal Inches.

QUESTIONS. Suppose a Cask whose Diameter at
 the Bung is 27 Inches, and at the Head 24 Inches
 Length 42 Inches, what will be the Content in Ale
 Gallons and Wine Gallons?
 Answer. Multiply the Diameter of the Bung
 by the Diameter of the Head, and the Length
 and the Product will be the Content in Ale
 Gallons. And multiply the Diameter of the Bung
 by the Diameter of the Head, and the Length
 and the Product will be the Content in Wine
 Gallons.

Thus found by the RULE.

First, 27 multiplied by 24 is 648
 And 648 multiplied by 42 is 27216
 Again 27216 added to 600.35 maketh 27816.35
 And 27816.35 multiplied by 42 Inches maketh 1168296.3
 Then 1168296.3 divided by 1077.25 gives 1084.5
 in the Quotient the Content in Ale 100.78 Ale
 Gallons

And

And 108792 divided by 22 gives 4944
in the Quotient the Content in Wine Gallons

Answer 4944 Wine Gallons

Ques. If the Diameter at the Head of a Vessel be 48 Inches, and at the Bung 32 Inches, and the Length is 40 Inches, what is the Content of that Vessel in Wine Gallons?

THE RULE

Having found the Difference of the two Diameters at the Bung and Head of the Vessel, take $\frac{1}{2}$ of that Difference, and add it to the lesser Diameter; then square that Sum and reserve the Product; then do, if the Content be required in Wine Gallons, multiply the Product referred, this Decimal Fraction .0034, and the Length of the Vessel one into the other (according to the Rule of continual Multiplication) so shall the last Product be the Number of Wine Gallons required: But if the Content be required in Ale or Beer Gallons, multiply the Product before reserved, this Decimal Fraction, .001770 and the Length of the Vessel, one into the other continually, so shall the Product be the Content in Ale Gallons.

This Rule shall be explained by two Questions, one in Wine Gallons, and the other in Ale Gallons.

Ans.

Examples

Example 45.

The Diameter at the Bung 25
 The Diameter at the Head 20.5
 Their Difference 4.5
 Which multiplied by 1.5 , that is
 The Product will be 6.75
 Which added to the lesser Diameter
 gives the mean Diameter 27.25
 Which mean Diameter being squared
 (that is multiplied by it self) pro- 744.5625
 duced 1.5
 Which said Product multiplied by 1.5 1116.84375
 The Product thence arising will be 2.637609375
 Which multiplied by the Length of the
 Vessel 40 , viz. 105.1040
 The Product is the Number of Wine
 Gallons sought, viz. 105.1040

Answer, 105.1040 Wine Gallons.

Note, The Superficies of any Figure is usually called its Area.

Quest. 46. If the Diameter at the Bung of a Barrel of Ale be 25 Inches; the Diameter at the Head 20.5 Inches, and the Length 32.75 Inches, what is the Content of that Barrel in Ale Gallons?

Answer, 105.1040 Wine Gallons.

But

Explication.

The Diameter at the Bung	25.	0+
The Diameter at the Head	20.	5
Their Difference	4.	5
Which multiplied by $\frac{1}{10}$ that is	0.	7
The Product will be	3.	15
Which added to the lesser Diameter	23.	65
gives the mean Diameter		
Which mean Diameter being squared,		
that is multiplied by it self, produceth	559.	3225
Which Product multiplied by	0.	0027
The Product thence arising is	15161.	+
Which multiplied by the Length of the		
Vessel produceth	32.	750
The Product is the Number of Ale-		
Gallons sought, viz.	49.	452

Answer, 49.452 Ale-Gallons.

Upon those Grounds that have been before recited, and upon the Reason of the Rule to be granted, viz. That in every Gallon of Wine there is 231 Cubick Inches, and 282 Cubick Inches are equal to an Ale-Gallon: The Decimal considered as the Base of one Wine-Gallon, or as 1 is to .0034, so is the Square of the equated Diameter, to the superficial Content of that Circle in Wine-Gallons, and Parts of a Gallon: And after the same Manner, supposing as before, 282 Cubick-Inches are equal to an Ale-Gallon, the Decimal .0027 prescribed in the said Rule will be found out.

Upon those Grounds Mr. Wingate composed his Gauging Rod, the chief Use thereof, is only in taking of Dimensions, and for that Purpose are very convenient, and are now used with all Persons engaged in the Mensuration of Wine and Ale-Gallons.

But

But the particular Constructions of these Rules, and likewise the making of Tables for the same Purpose, being handled by several Artists, I shall not insist upon them.

These four Rules being only as an Essay to Gauging; for to find the Capacities or Contents of all Sorts of Vessels, which hold Liquids, Meal, Corn, &c. deserves a more than ordinary Study and Practice.

And so conclude.

If the Circumference of a Circle be 88.25, what is the superficial Content of that Circle?

Answer, 616.801 +

For as 1 is to .079578 so is the Square of the Circumference to the superficial Content.

Therefore if .079578 be multiplied by the Square of the given Circumference, the Product shall be the superficial Content sought.

Operation.

$$\begin{array}{r}
 1 \text{ --- } .079578 \text{ --- } 7876.5625 \\
 \times 88.25 \times 88.25 \\
 \hline
 63010600 \\
 551359375 \\
 393818125 \\
 708890625 \\
 551359375 \\
 \hline
 616801
 \end{array}$$

Answer, 616.801 +

Schollum.

Scholium.

HAVING in the Chapter of *Interest upon Interest* in *Decimal Arithmetick*, by the Tables and by the Pen, shewed the Manner of finding out the Value of Rents, Annuities, and Pensions, after the Rate of five or six Pounds *per Cent. per Ann.* by various Operations.

However it may not perhaps be unacceptable in the Conclusion of this Book, (it being not altogether out of the Way of an *Arithmetician*) to insert a brief Account of some Estimates, that have been reasonably made by two very ingenious Persons, about the Proportion or Difference of Men's Lives, according to their several Ages, which may be of good Use in computing the Values of Annuities, or taking of Leases for Lives, &c.

Sir *William Petty* in his Discourse made before the *Royal Society* (*Anno 1674.*) concerning the Use of Duplicate Proportion in the Life of Man, and its Duration; saith, That it's found by Experience, there are more Persons Living of between 16 and 26 Years old, than of any other Age, or Decade of Years in the whole Life of Man, (*viz.* 70 or 80 Years.) His Reason for that Assertion I shall omit; but supposing it true, he thence infers, That the Roots of every Number of Mens Ages under 16 (under whose Root is 4) compared with the said Number 4, doth shew the Proportion of the Likelihood of such Men's reaching the Age of 70 Years.

As for Example. 'Tis 4 times more likely, that one of 16 Years old should live to 70, than a new born Babe: 'Tis 3 times more likely, that one of
9 Years

9 Years old, should attain the Age of 70, than the said Infant.

On the other Hand, 'tis 5 to 4, that one of 25 Years old, will die before one of 16; and 6 to 5, that one of 36 will die before one of 25; and so on, according to the Roots of any other declining Age, compared with (4, 6) the Root of 21, which is the Year of Perfection, according to the Sense of our Law, and the Age for whose Life a Lease is most valuable.

2. The ingenious and great Mathematician, Captain *Edmund Halley*, in *Philosoph. Transact. Numb. 196.*) doth with great Industry and Skill, draw an Estimate of the Proportion of Mens Lives from the monthly Tables of the Province of *Silesia* in the Kingdom of *Bohemia*; from whence that excellent Man proves, that 'tis 80 to 1, a Person of 25 Years old, will not die in a Year; that it is 5 $\frac{1}{4}$ to 1, that a Man of 40 will live 7 Years; that a Man of 30 Years old, may reasonably expect to live 27 or 28 Years more.

Now for these and the like Proportions, he justly infers, that the Price of Insurance upon Lives ought to be regulated, there being a great Difference between the Life of a Man of 20 and one of 50.

For Example, 'Tis 100 to 1, that if a Man of 20 dies not in a Year, and but 38 to 1, for a Man of 50 Years of Age; and upon these also depends the Valuation of Annuities for Lives: For it is plain, that the Purchaser ought to pay only such a Part of the Value of any Annuity, as he hath Chances that he is living.

And for that Purpose he hath taken the Pains (which was not a little) to compute the following Table, that shews the Value of Annuities for every Fifth Year of Age to the Seventieth.

Age	Purchase Years	Age	Purchase Years	Age	Purchase Years
1	10.28	25	12.27	50	9.21
5	13.40	30	11.72	55	8.51
10	13.44	35	11.12	60	7.60
15	13.33	40	10.57	65	6.54
20	12.78	45	9.91	70	5.32

The same ingenious Gentleman proceeds on, and shews how an Estimate may be made to find the Value of two Lives, and then of three Lives; which being too long a Discourse to be recited here, I shall only add this serious Observation: *Viz.* How unjustly we repine at the Shortness of our Lives, and think our selves wrong'd, if we attain not to old Age; whereas it appears, That the one Half of those that are born, die in seventeen Year's Time.

For by the aforesaid Bills of Mortality at *Breſtaw*, it was found that 1238: were in that Time reduced to 616; so that instead of murmuring at what we call a short Life, we ought to esteem it as a great Providence, that we have survived, perhaps by many Years, that Period of Life, whereat the one half of the whole Race of Mankind does not arrive.

Soli D E O Gloria in Aeternum.



